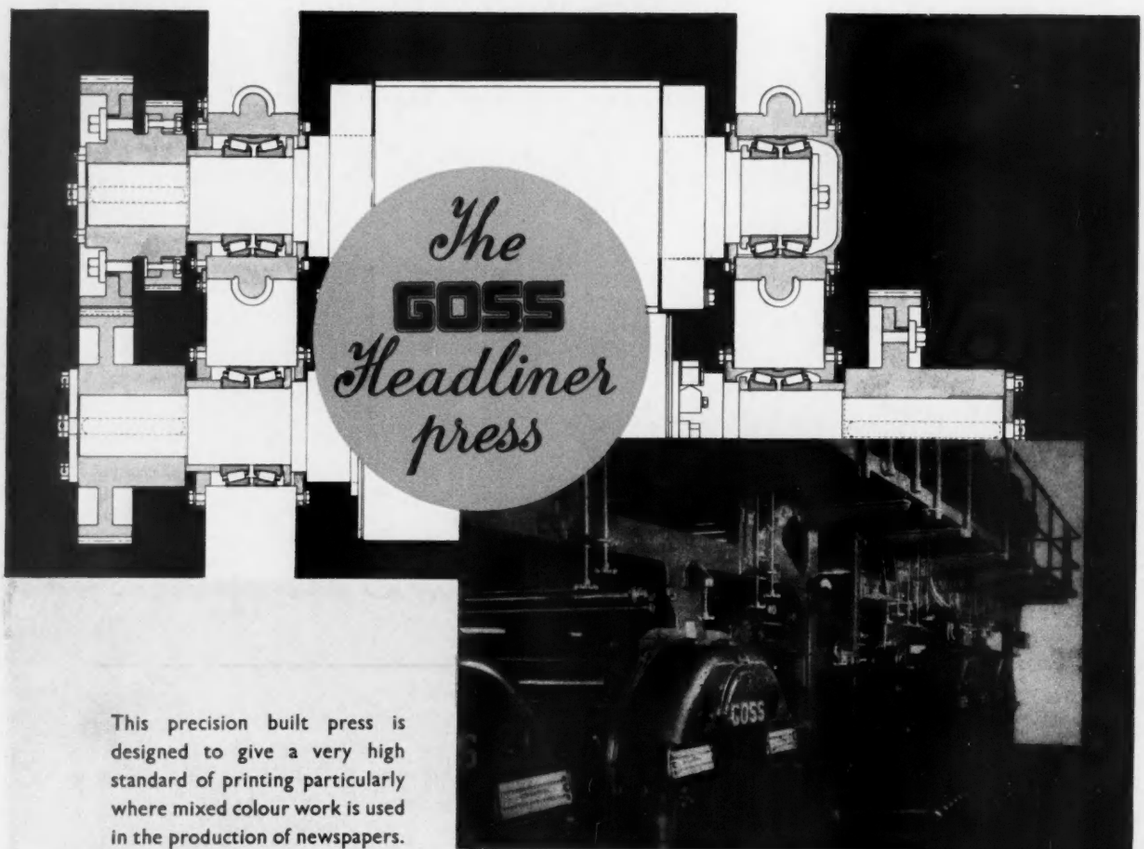
ANNUAL REVIEW NUMBER

The Engineer

JANUARY 10, 1958 28 ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS



This precision built press is designed to give a very high standard of printing particularly where mixed colour work is used in the production of newspapers.

It includes a number of features which enable the most precise adjustments to be made, and to facilitate colour changes without wastage of ink and labour. The cylinders as shown in the drawing are mounted upon pre-loaded Timken double-cup tapered-roller bearings. Both cylinders are end-located by the bearings at the right, the bearings at the left (although pre-loaded within themselves) are free to float. In this arrangement temperature variation cannot interfere with the bearing tightness; errors in printing register due to play between the cylinders are thus avoided.

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THE ENGINEER

Established 1856

No. 5320 **JANUARY 10, 1958** VOL. 205

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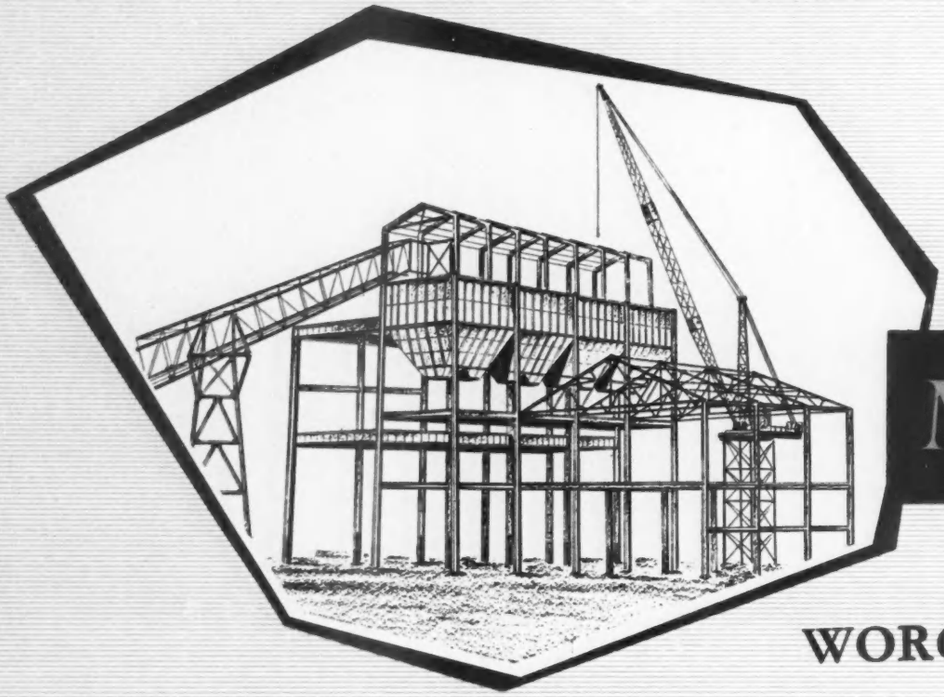

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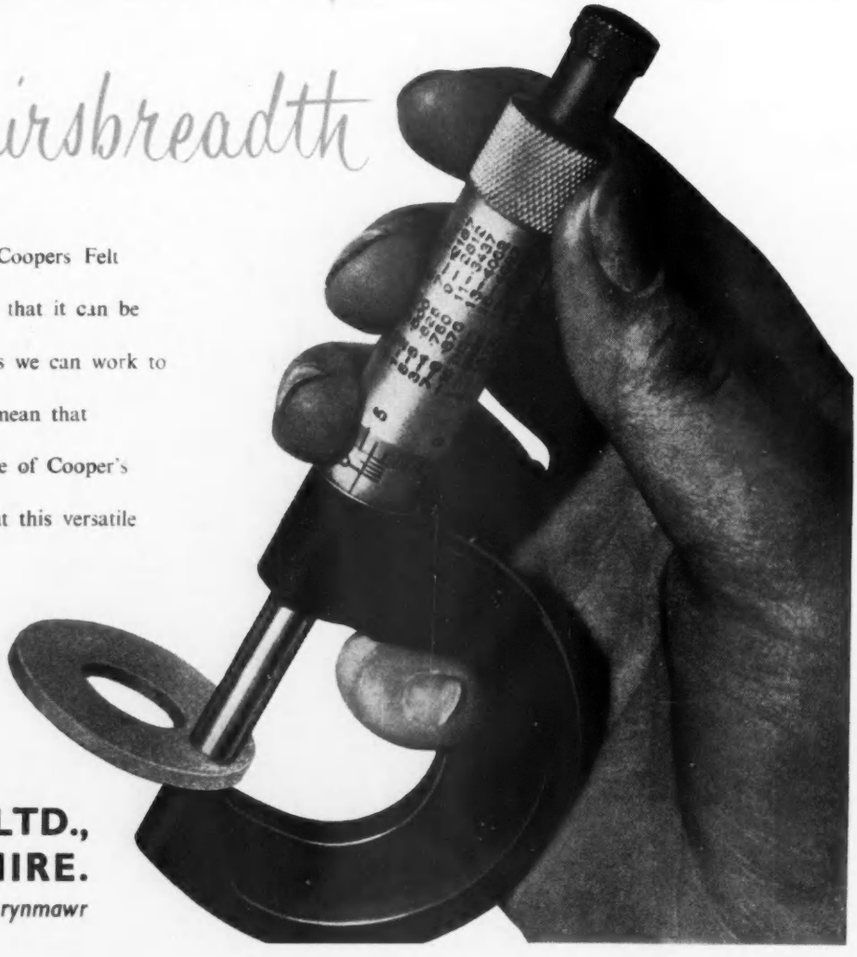

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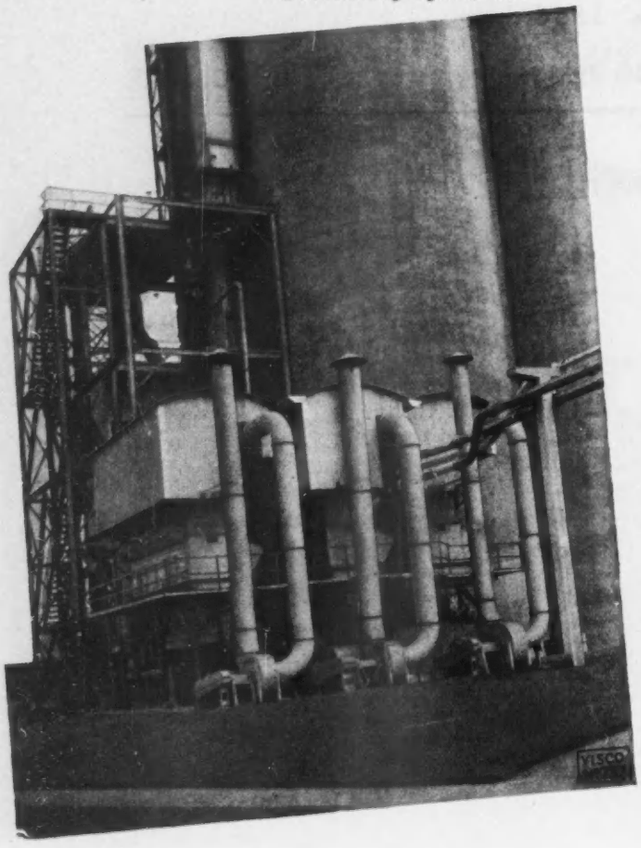

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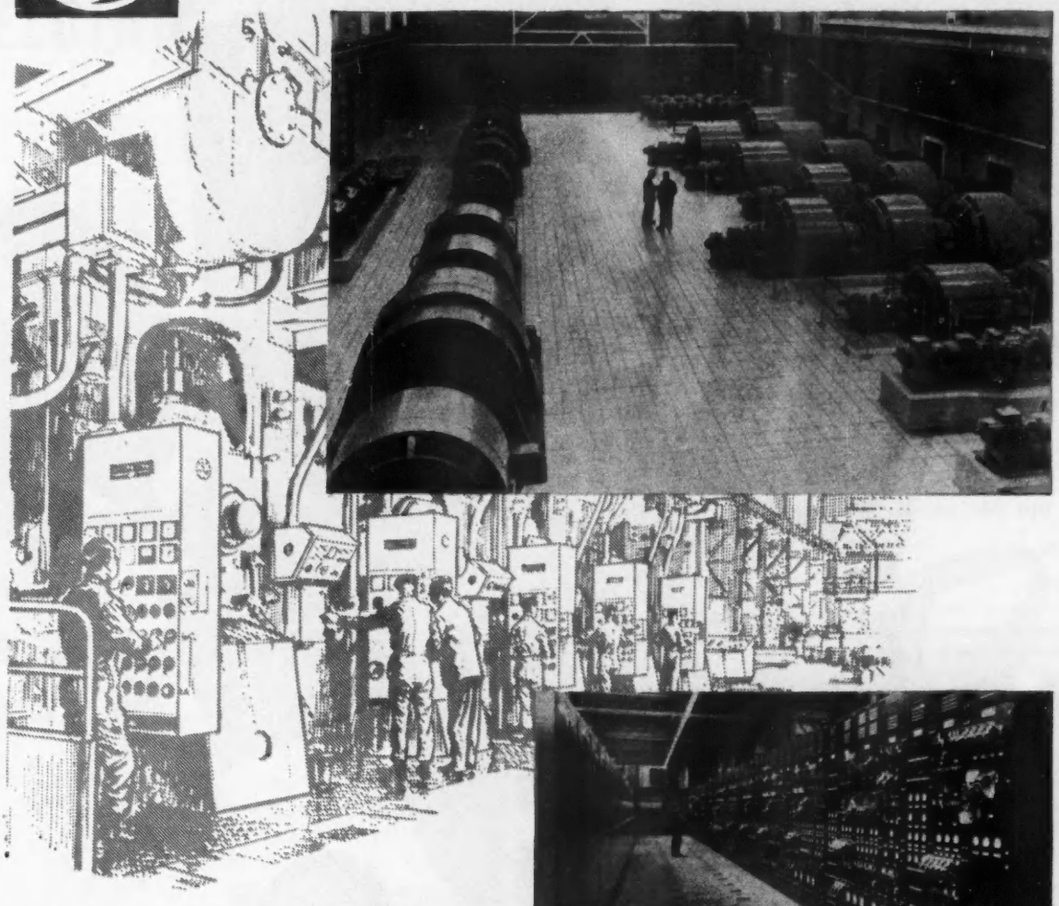

For the Steel Company of Wales' important new plant at Velindre, the main drive for the five-stand tandem cold reduction mill comprises six BTH D.C. motors totalling 19,150 h.p. supplied from two BTH motor-generator sets with a total capacity of 16,730 kW.

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Front view of a fabricated steel frame for a special purpose 250 ton Knuckle Press.

Photograph by courtesy of Glacier Metal Co. Ltd.

It must be a Hendrys' Belt–

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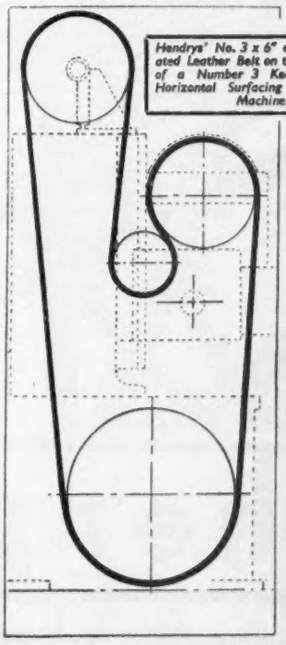
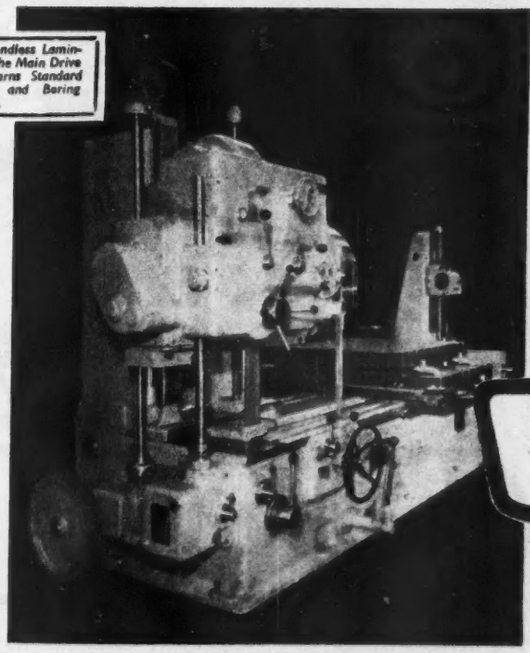


Hendrys' No. 3 x 6" endless Laminated Leather Belt on the Main Drive of a Number 3 Kearns Standard Horizontal Surfacing and Boring Machine.



SIZES AND WEIGHTS

Hendrys' Patent Laminated Leather Belts are made in eight standard weights to following widths :—

No. 0.	$\frac{1}{8}$ in.	thick up to 3 in. wide
No. 1.	$\frac{3}{16}$ in.	" " " 7 in. "
No. 2.	$\frac{1}{4}$ in.	" " " 12 in. "
No. 3.	$\frac{3}{8}$ in.	" " " any width
No. 4.	$\frac{1}{2}$ in.	" " " " "
No. 5.	$\frac{3}{4}$ in.	" " " " "
No. 6.	$\frac{7}{8}$ in.	" " " " "
No. 7.	1 in.	" " " " "

The No. 0 is a specially pliable belt made to order for light driving at high speeds and Nos. 5 to 7 are for Main or Heavy Driving.

Hendrys' make Laminated Friction Belts for Screw Presses, also.

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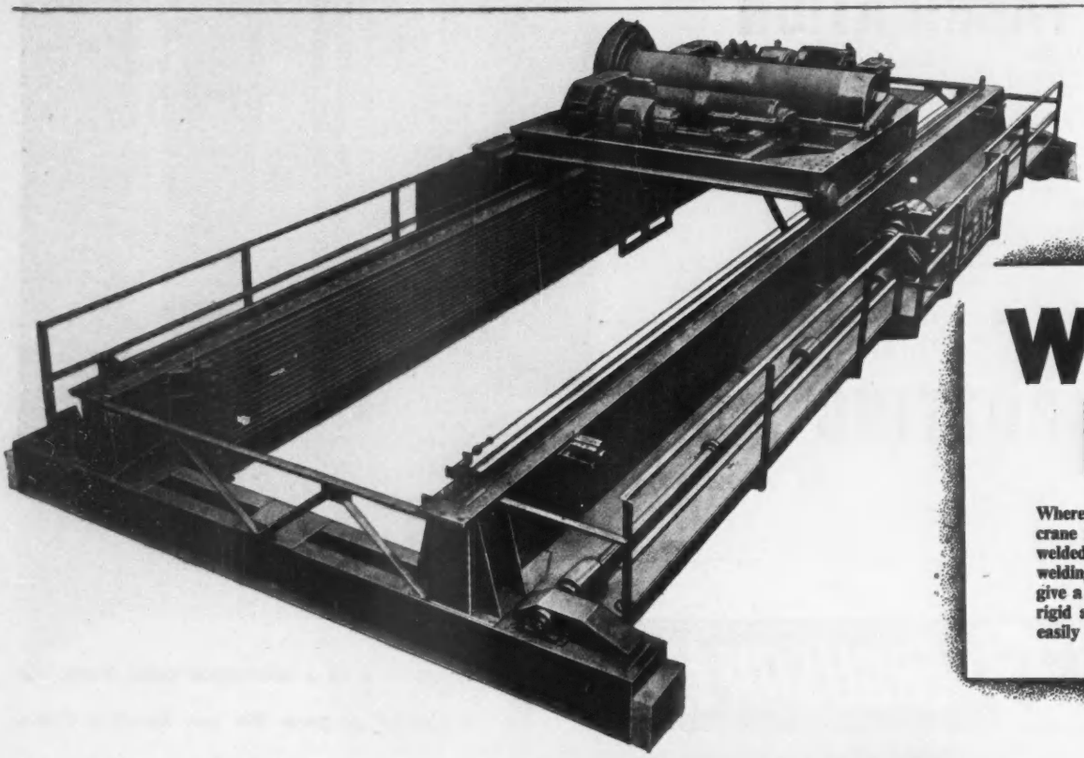
In overhead travelling cranes maximum allowable wheel loads should determine the choice of these two girder types . . . .



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Where the wheel loading of an overhead crane is not important Carruthers welded box plate girders, with modern welding technique, can be designed to give a structure, compact, accessible, rigid and strong, with smooth surfaces easily and quickly painted.

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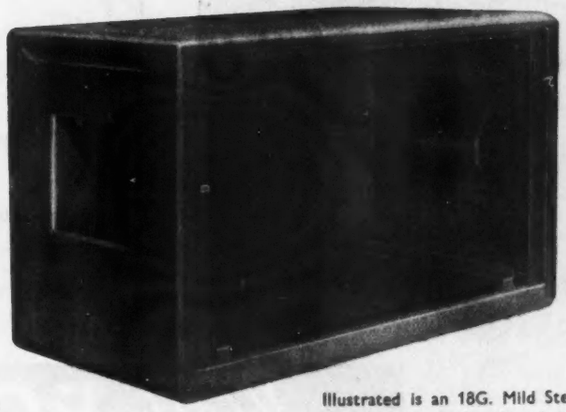
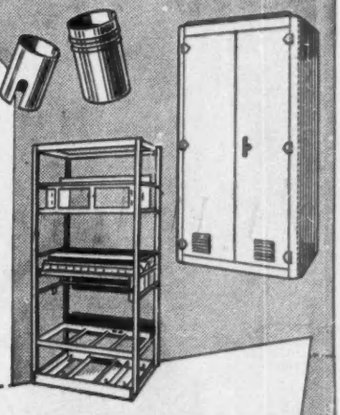


Illustrated is an 18G. Mild Steel Case manufactured to the design of a well-known Company of instrument makers.



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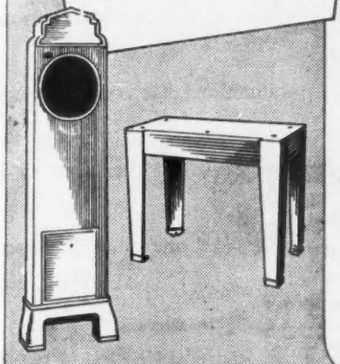

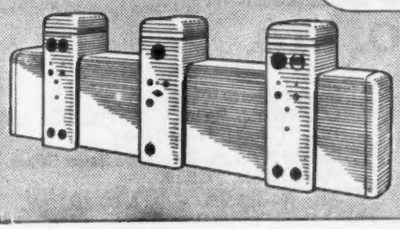

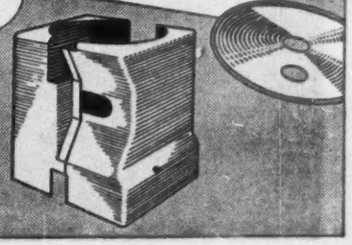

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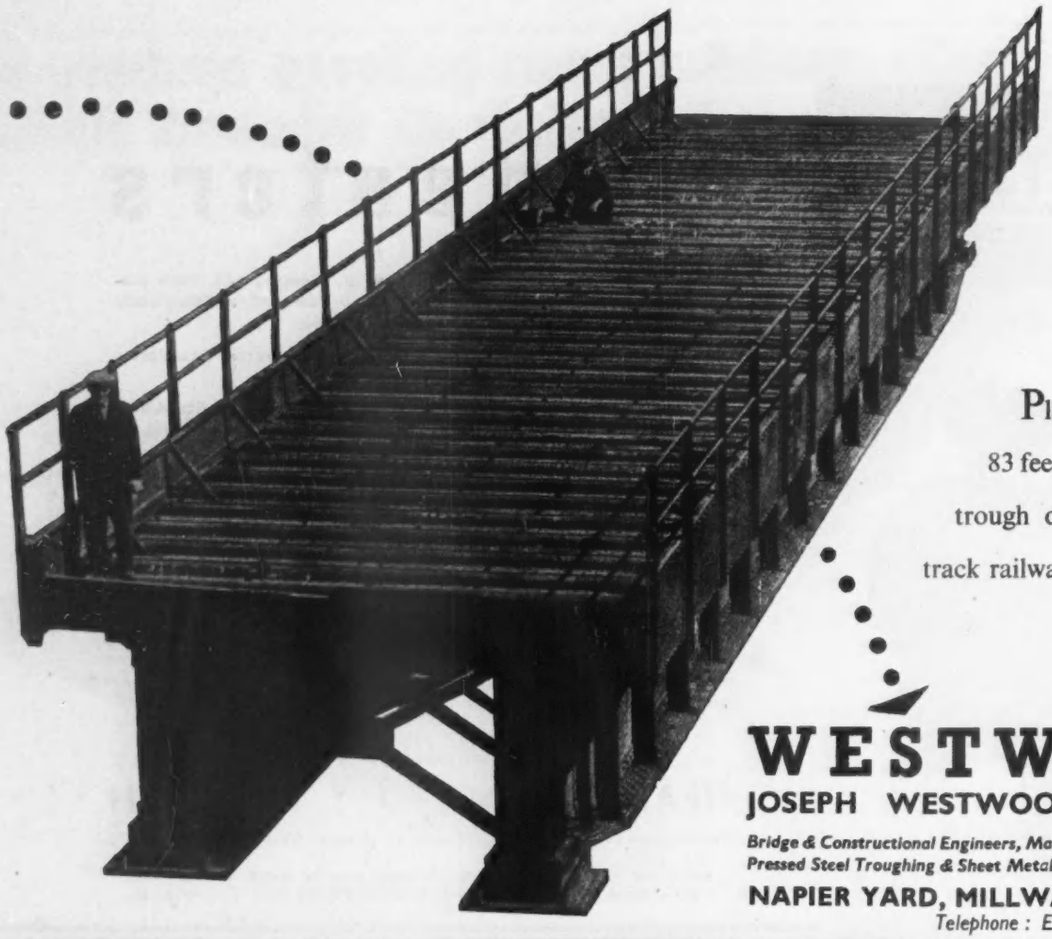

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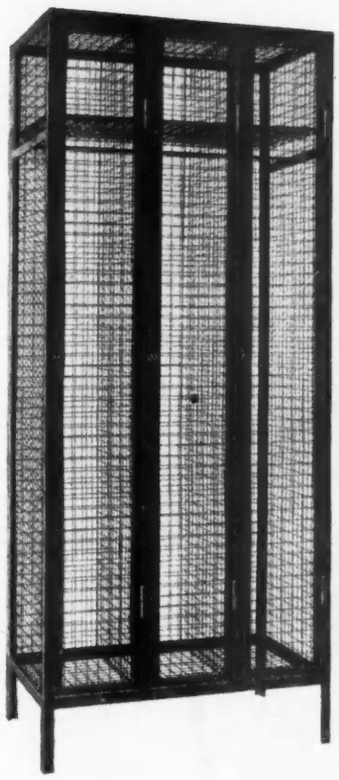

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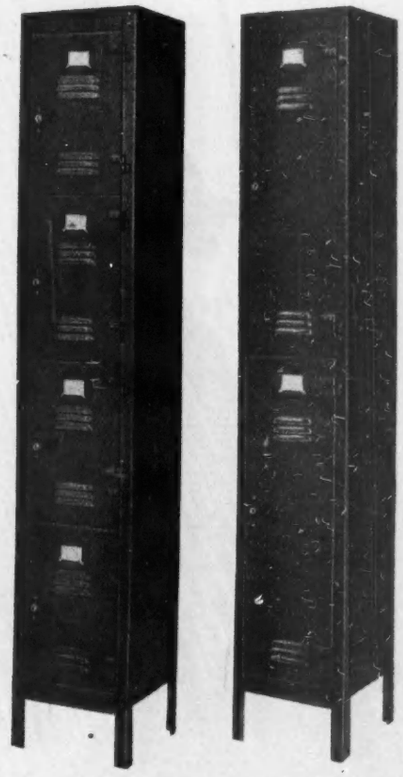
Standard sizes:

72 in. high x 12 in. wide x 12 in. deep

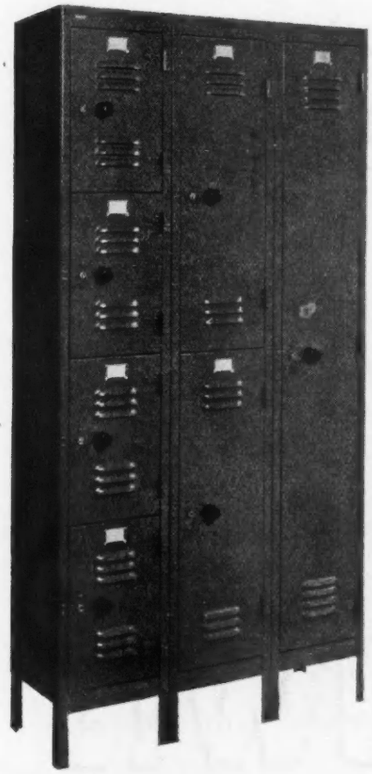
72 in. high x 10 in. wide x 18 in. deep

Please send for List No. E 1009



Wirework or Sheet Metal

in single units or nests of 2-5 as required



STEEL LOCKERS

Overall sizes:

72 in. high x 12 in. wide x 12 in. deep

72 in. high x 15 in. wide x 15 in. deep

72 in. high x 18 in. wide x 18 in. deep

1, 2 or 4 compartments per locker

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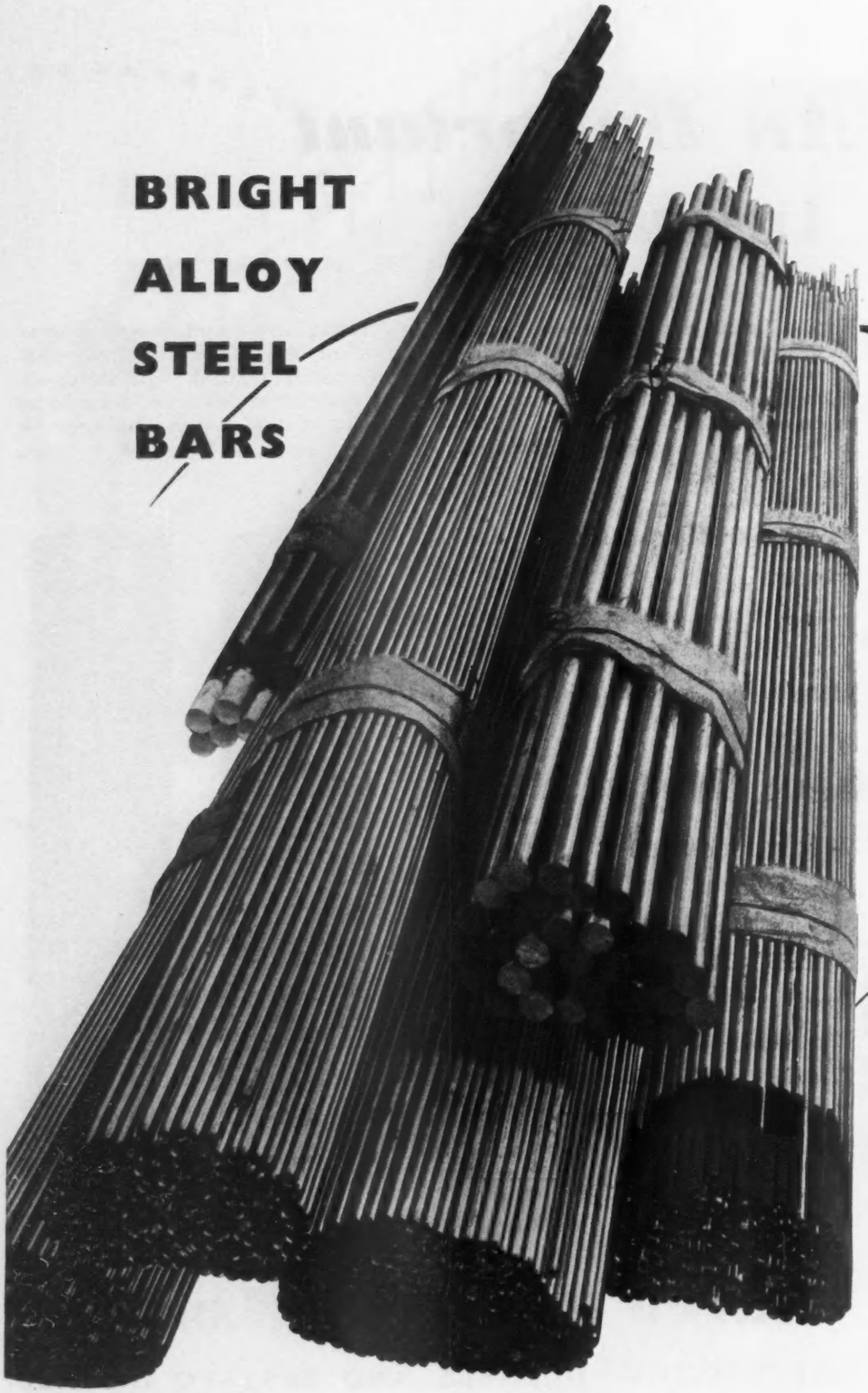

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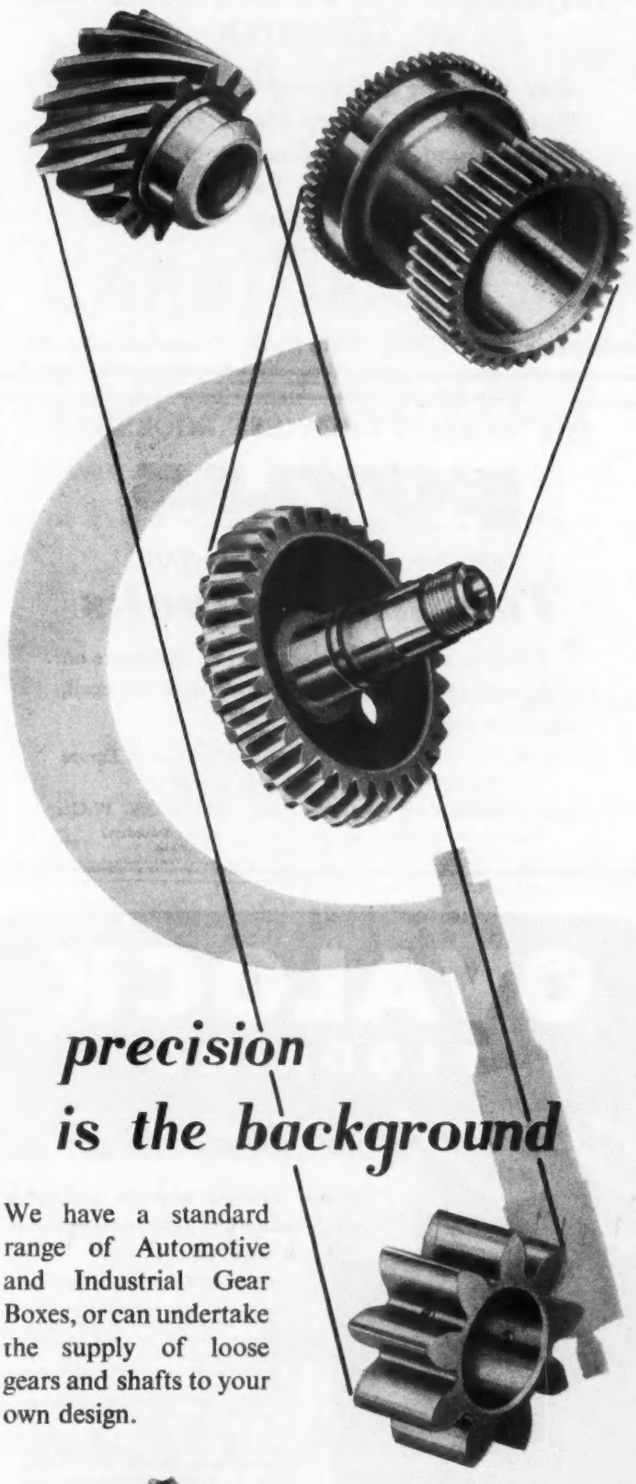

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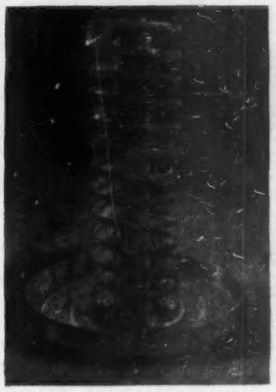

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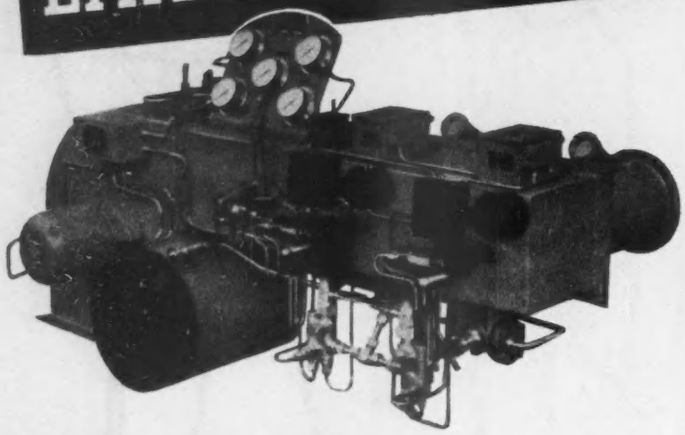

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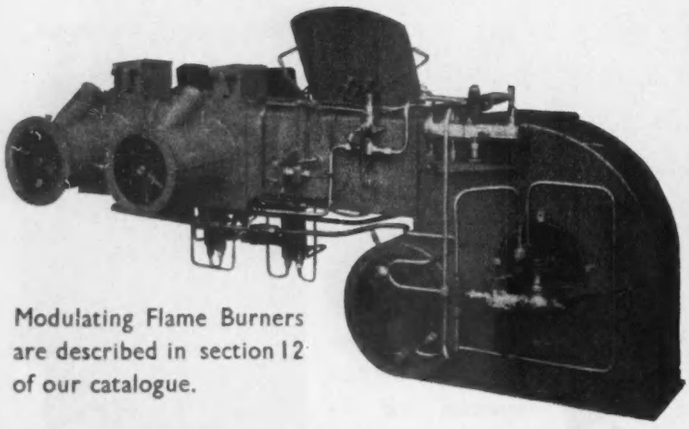

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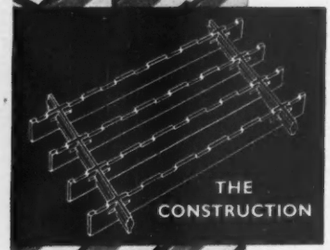

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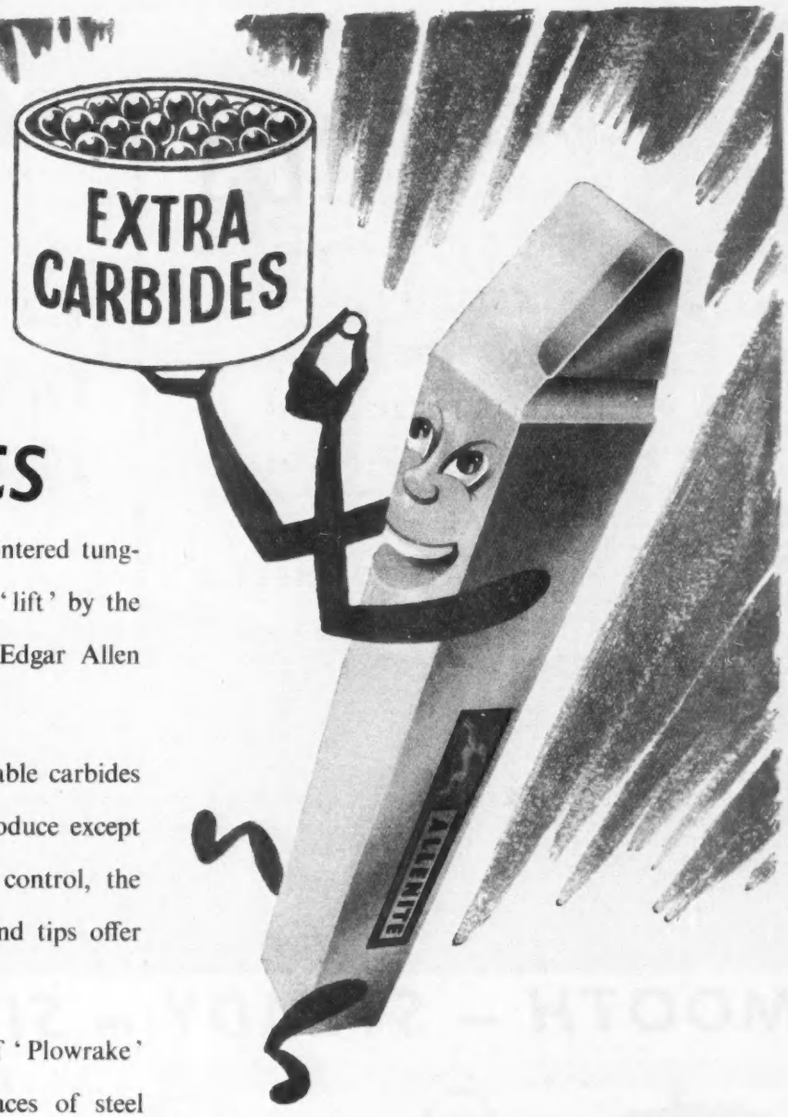

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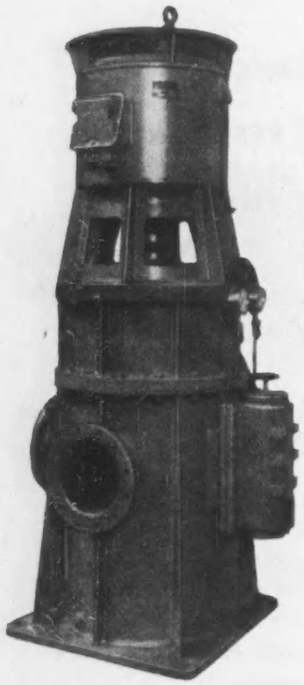

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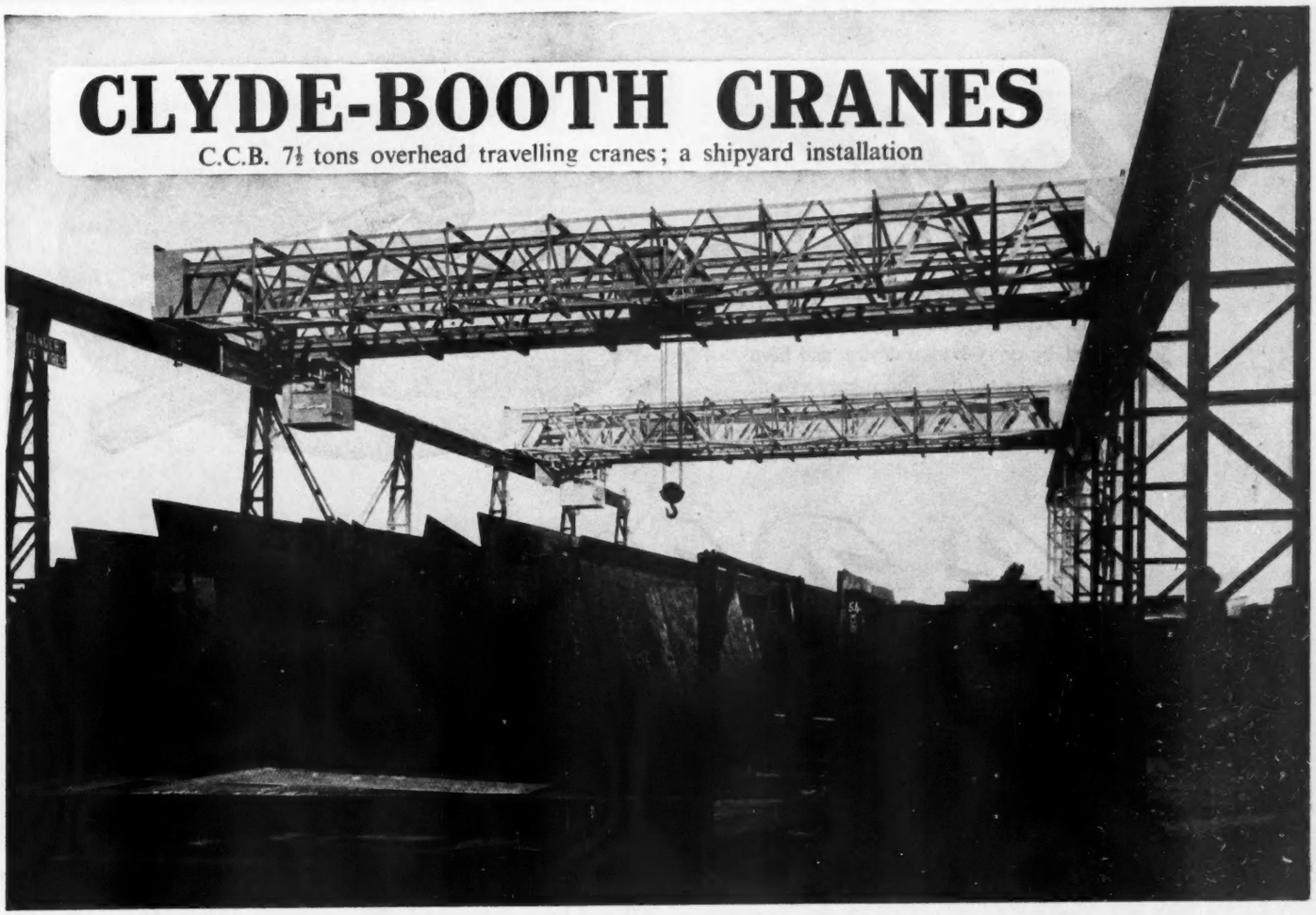

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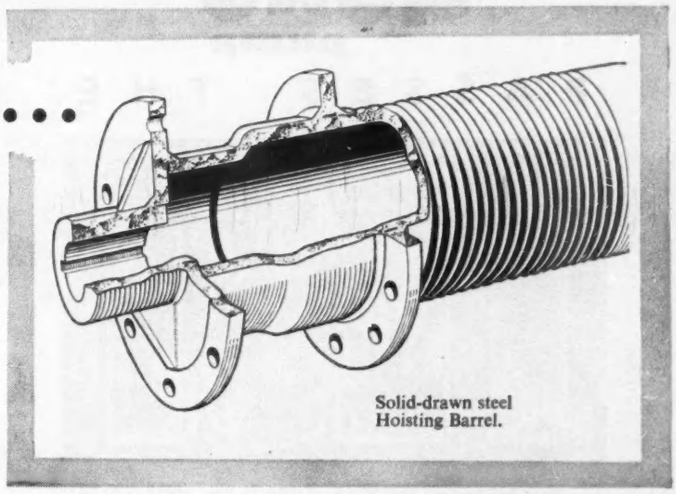

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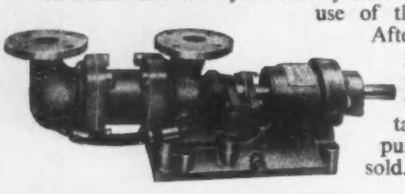

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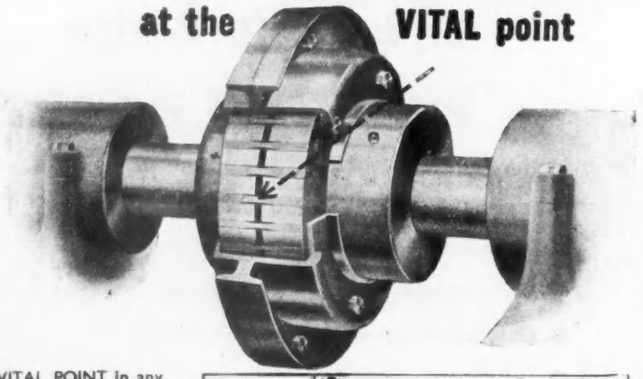

THE VITAL POINT in any power plant is where the shaft of the driving unit links up with the shaft of the unit driven. Vibration, shocks and stresses resulting from misalignment at this point are reflected in loss of power and, eventually, by serious breakdowns.

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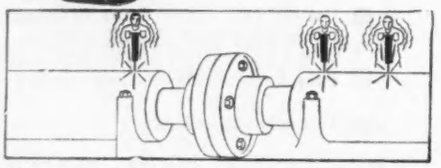
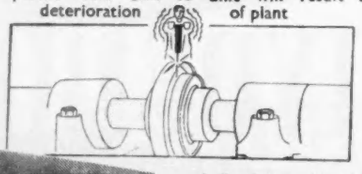


Unless checked accumulative shocks and stresses passed from unit to unit will result in rapid deterioration of plant



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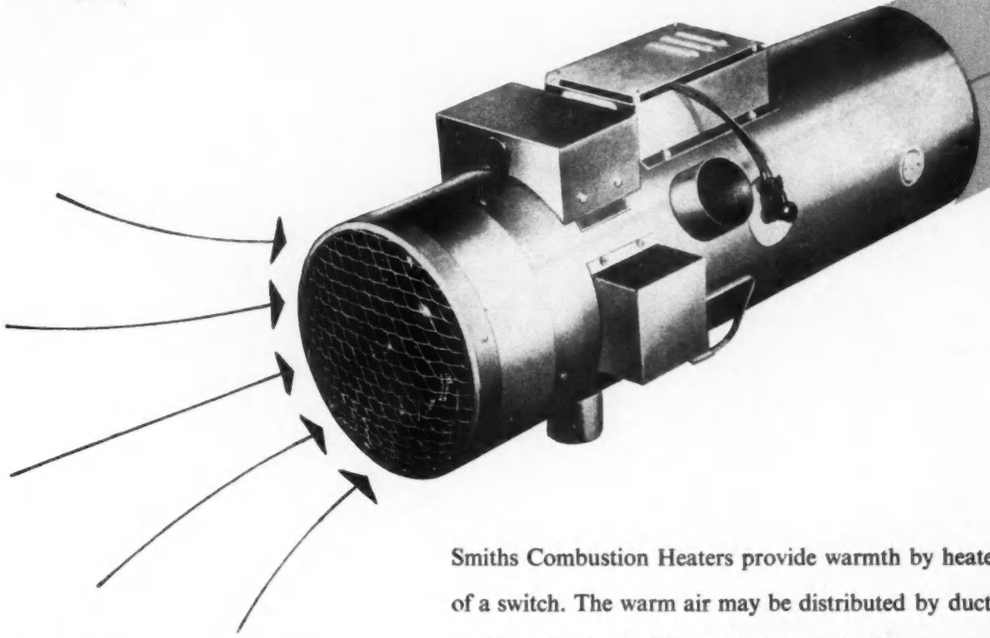

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- *50,000 B.t.u. per hour for 3.3 pints of fuel.*
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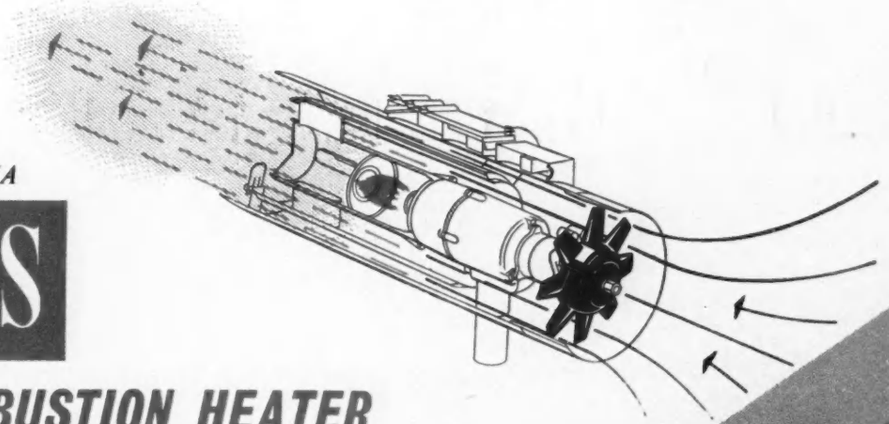

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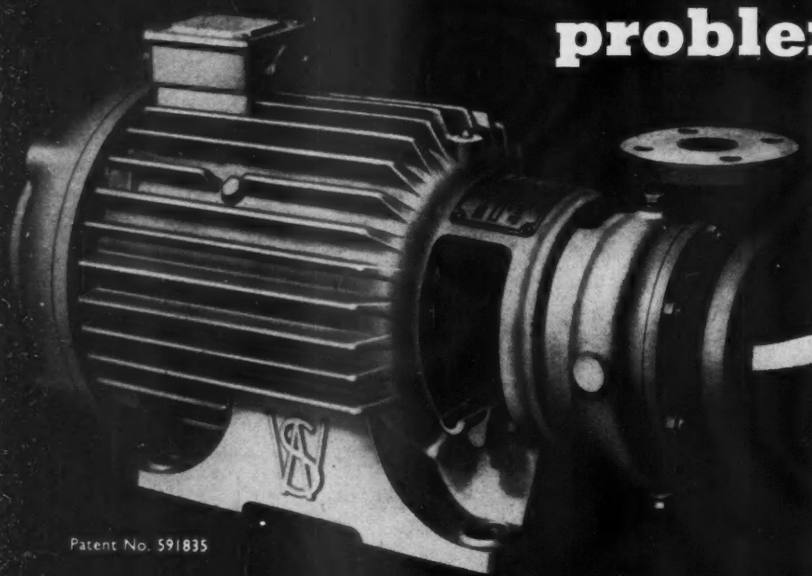

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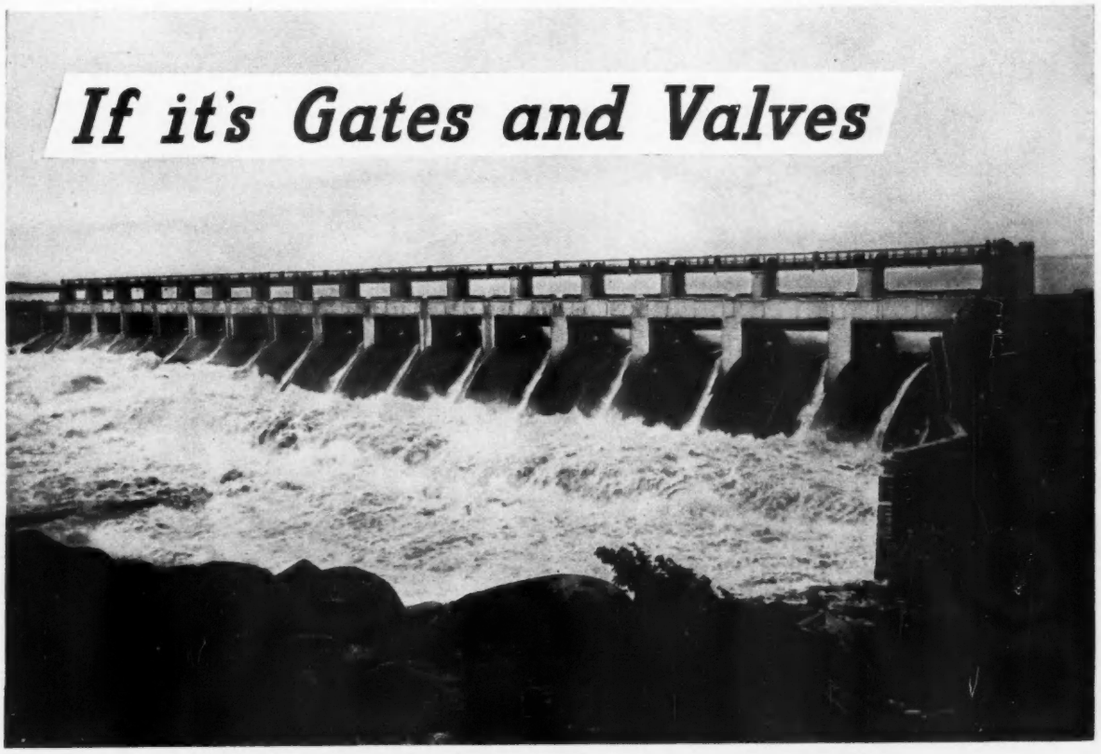
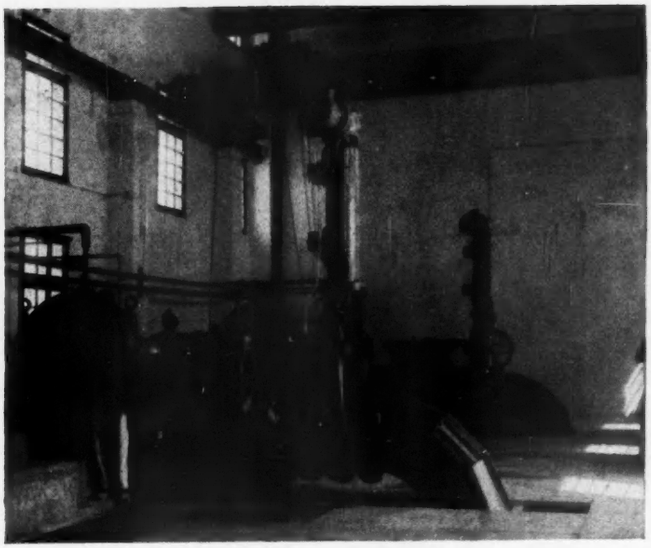


for IRRIGATION SCHEMES



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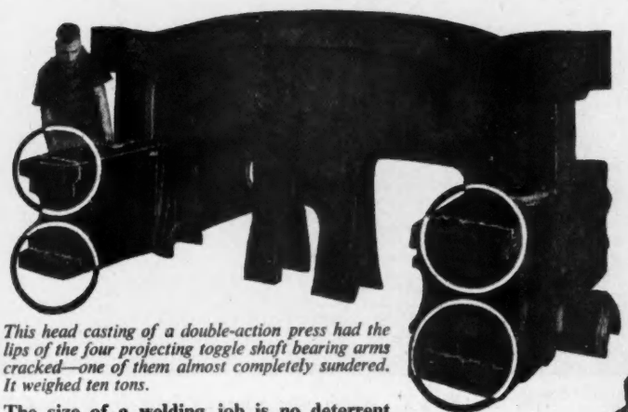

This head casting of a double-action press had the lips of the four projecting toggle shaft bearing arms cracked—one of them almost completely sundered. It weighed ten tons.

THE 10-TON CASTING COMPLETELY REPAIRED BY BARIMAR

The welding of each bearing arm required expert welding technique and was a major operation. The job was fully covered by the Barimar Money-back Guarantee.

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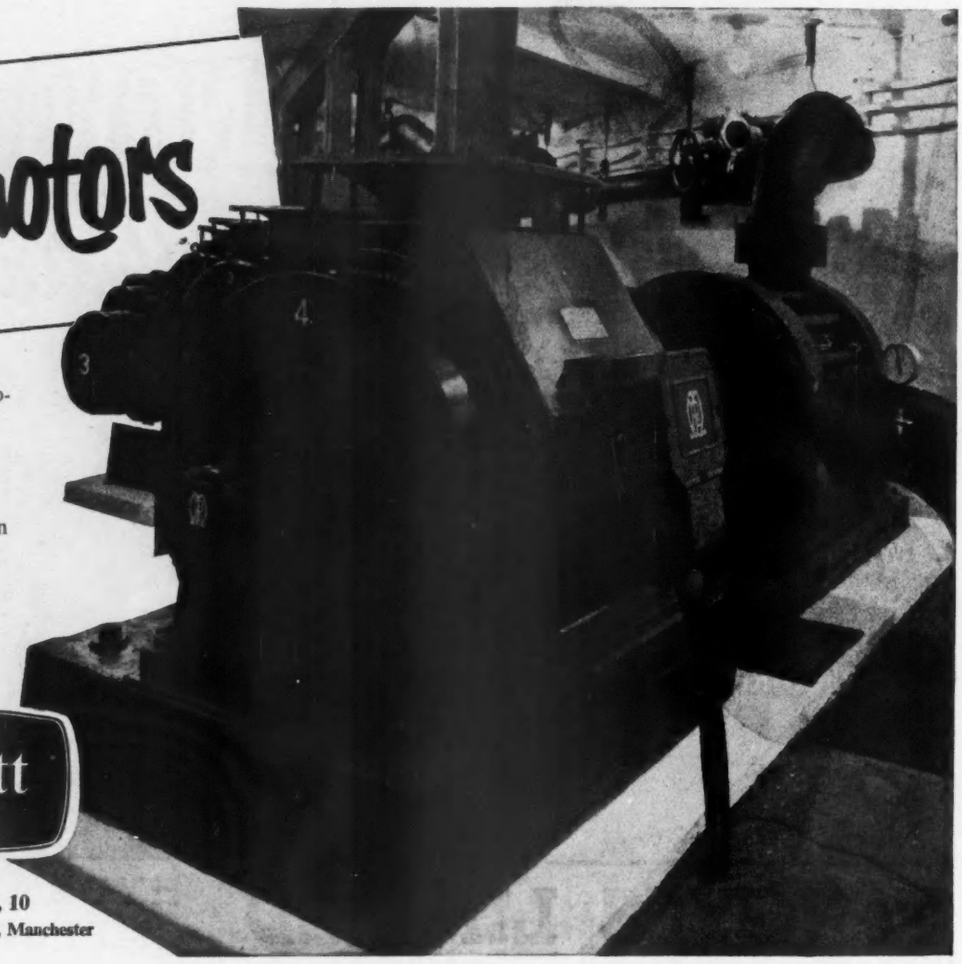
Pumps & motors



This Mather & Platt modern squirrel-cage drip-proof induction motor, which is direct-on started with a low starting current, drives a mine drainage pump in a Durham colliery. Behind it can be seen an earlier installation of three drip-proof wound rotor induction motors which drive similar pumps. The motors are rated at 650 b.h.p., 2,750 volt, 1,475 r.p.m., and each Mather & Platt Plurovane pump delivers 1,500/1,600 g.p.m. against a 1,100/960ft. head.

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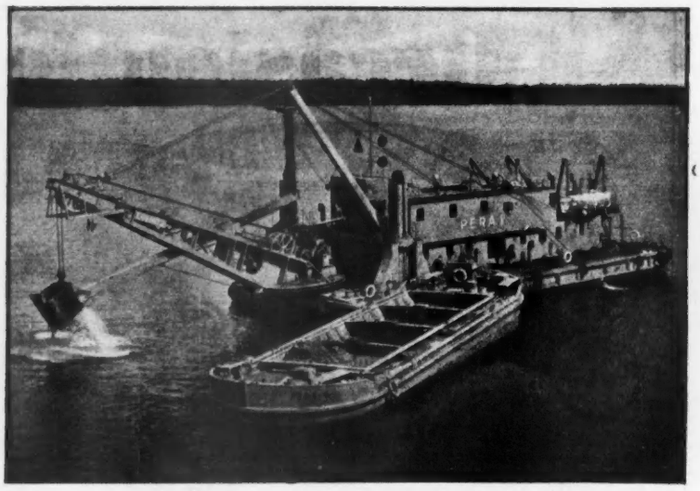

This is 'Pera I' which was recently built by Lobnitz for work in Finnish Waters. It is an electrically operated 4 cubic yard dipper dredge, of the non-propelling type.

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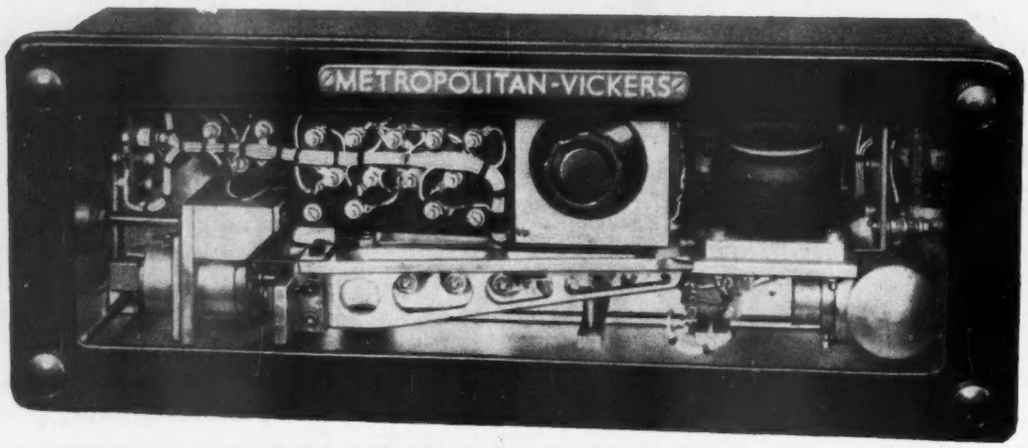
Type P.C.8



the perfect link between pneumatic & electronic control systems

The Type P.C.8 Pneumatic-Electric Converter has been designed primarily as a link between pneumatic and electrical control systems where standard units in the two control mechanisms need to be combined. The input pressure is the normal 3-15 p.s.i. gauge used in process controllers and the output voltage (100 V max.) is suitable as, for instance, a reference voltage for most commercial motor speed controls. Other applications include conversion of air pressures for electrical recording.

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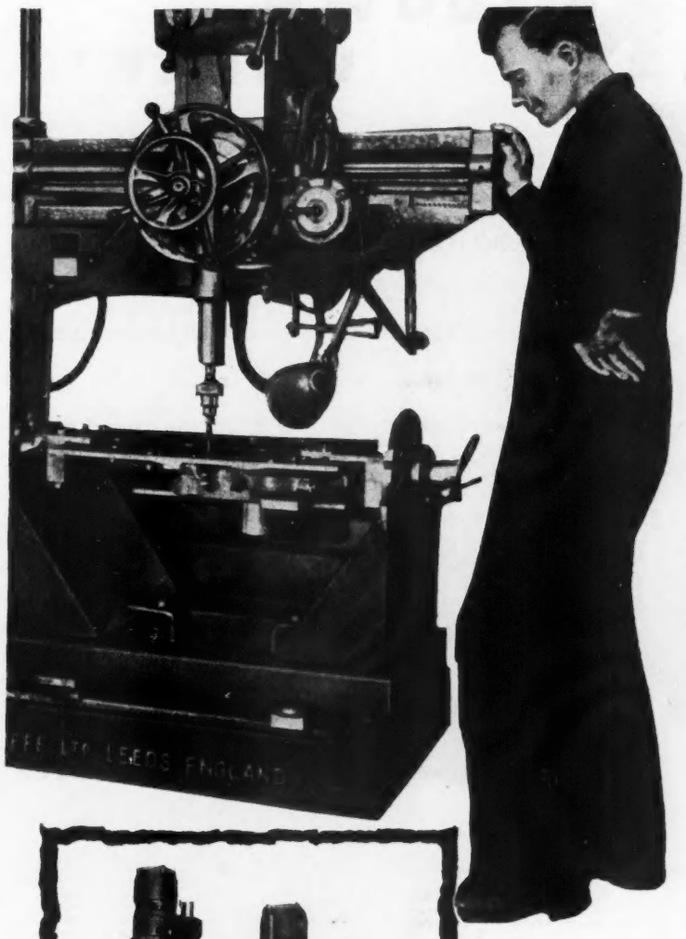

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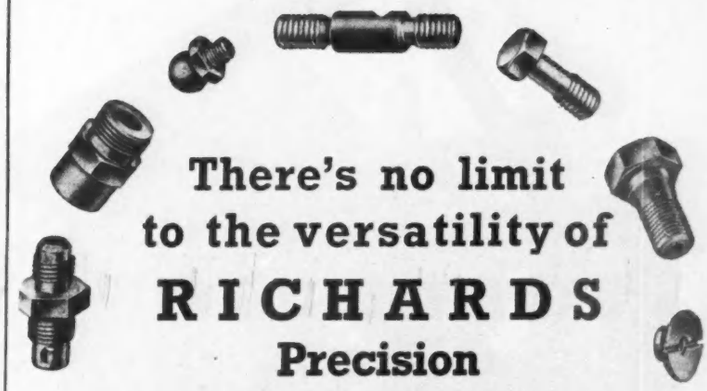

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RICHARDS

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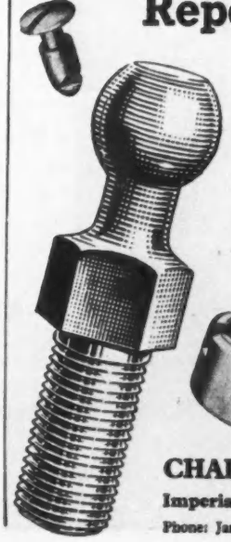

We are equipped for machining on Single and Multi Spindle Autos from $\frac{1}{8}$" to 3" diameters in Free Cutting Mild Steel, Brass, Alloy Steels, etc., Turning, Milling and Grinding capacity available.

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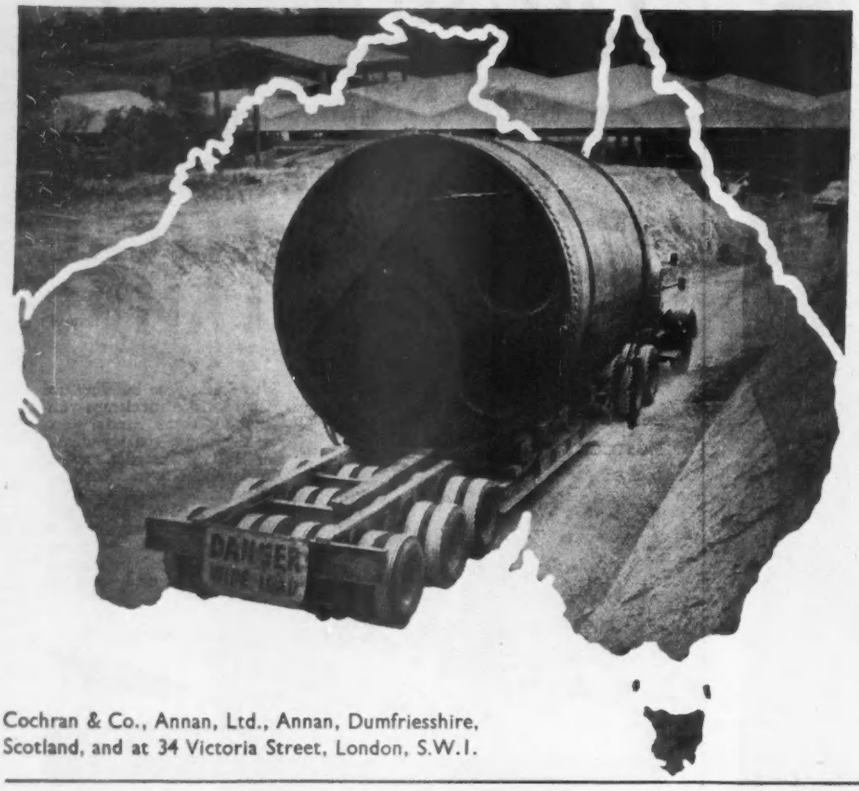
COCHRAN 'DOWN UNDER'



An 11′ 9″ diameter Cochran Sinuflo Economic boiler arriving at the factory of Thomas De La Rue (Aust.) Pty., Ltd., in Thornleigh, New South Wales.

Here in Australia, as in the rest of the world, the particular features of this type of boiler are appreciated by the experienced user.

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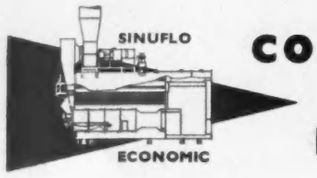

COCHRAN BOILERS

Cochran & Co., Annan, Ltd., Annan, Dumfriesshire, Scotland, and at 34 Victoria Street, London, S.W.1.

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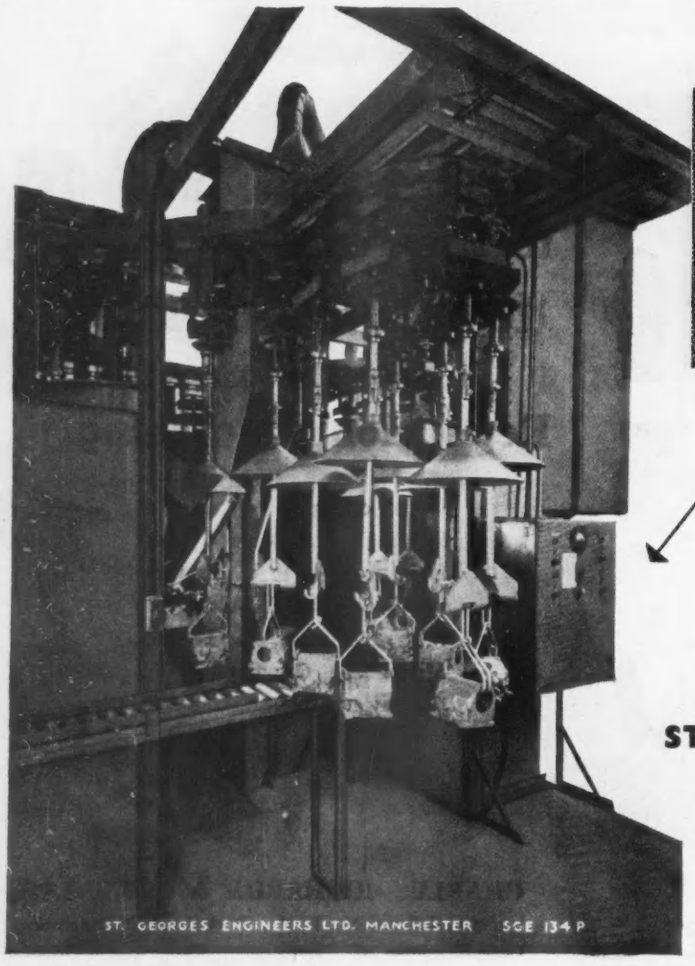

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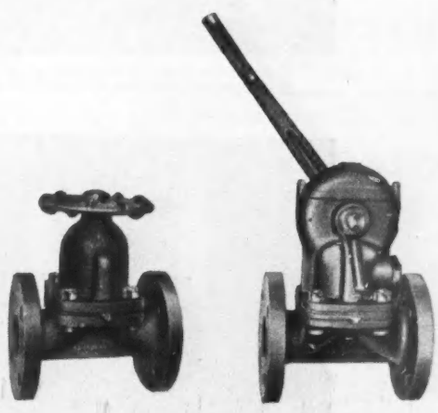
SAUNDERS DIAPHRAGM VALVES



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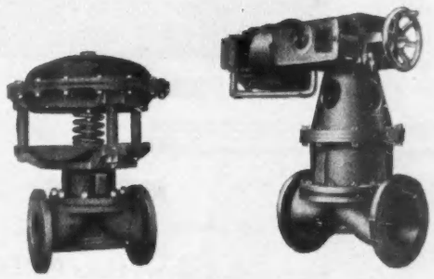

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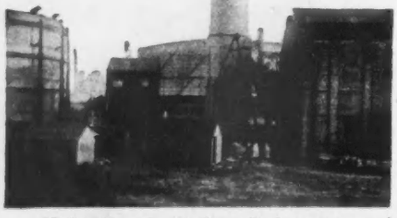
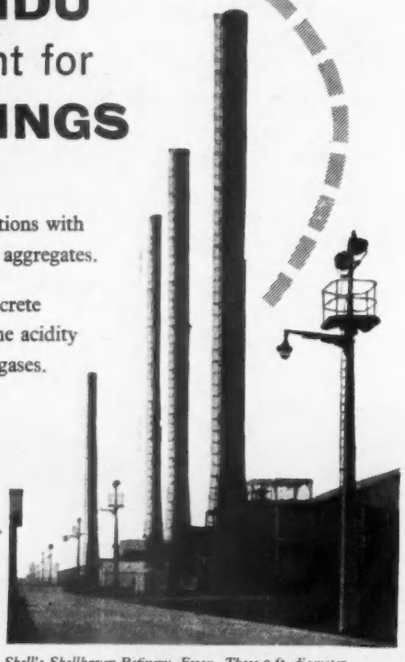


Wallasey Power Station. Ciment Fondu mortar was used for the jointing of the interior brickwork of this chimney.



Shell's Shellhaven Refinery, Essex. These 9 ft. diameter steel stacks have been lined with Ciment Fondu insulating concrete.

Battersea Power Station where chimneys have been lined with Ciment Fondu mortar.

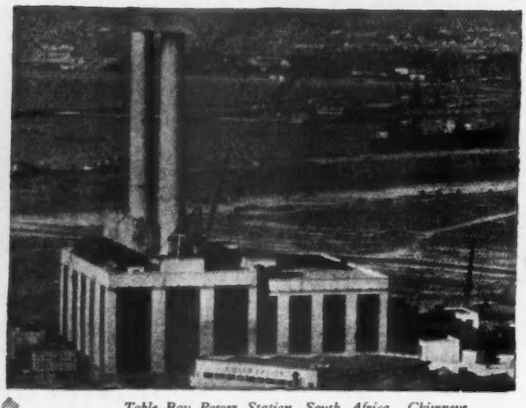


Table Bay Power Station, South Africa. Chimneys gunited with Ciment Fondu mortar.

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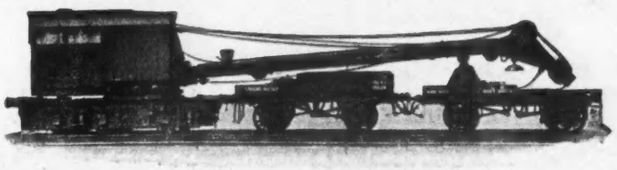

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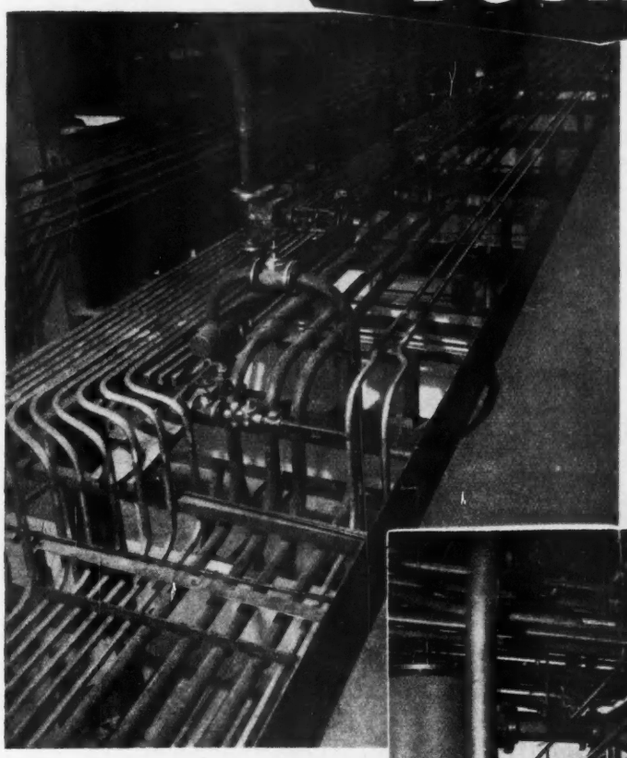

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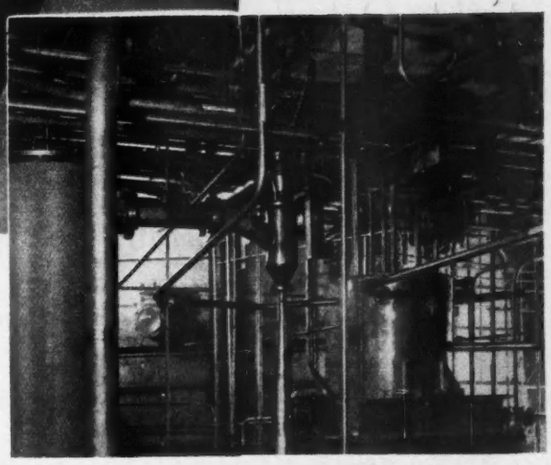

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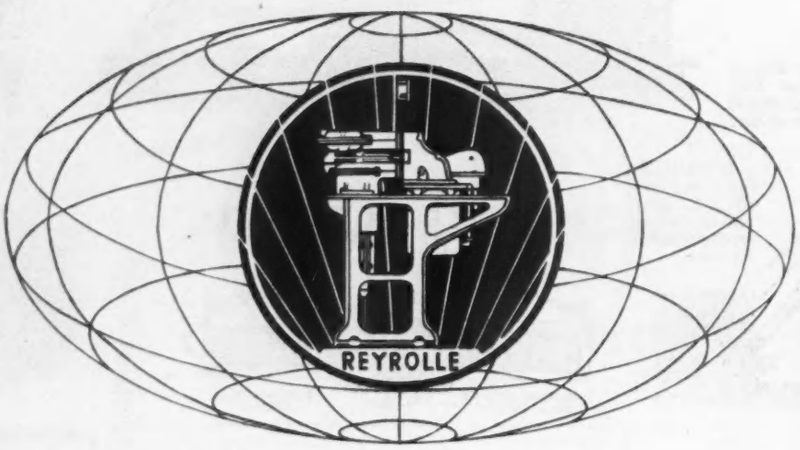

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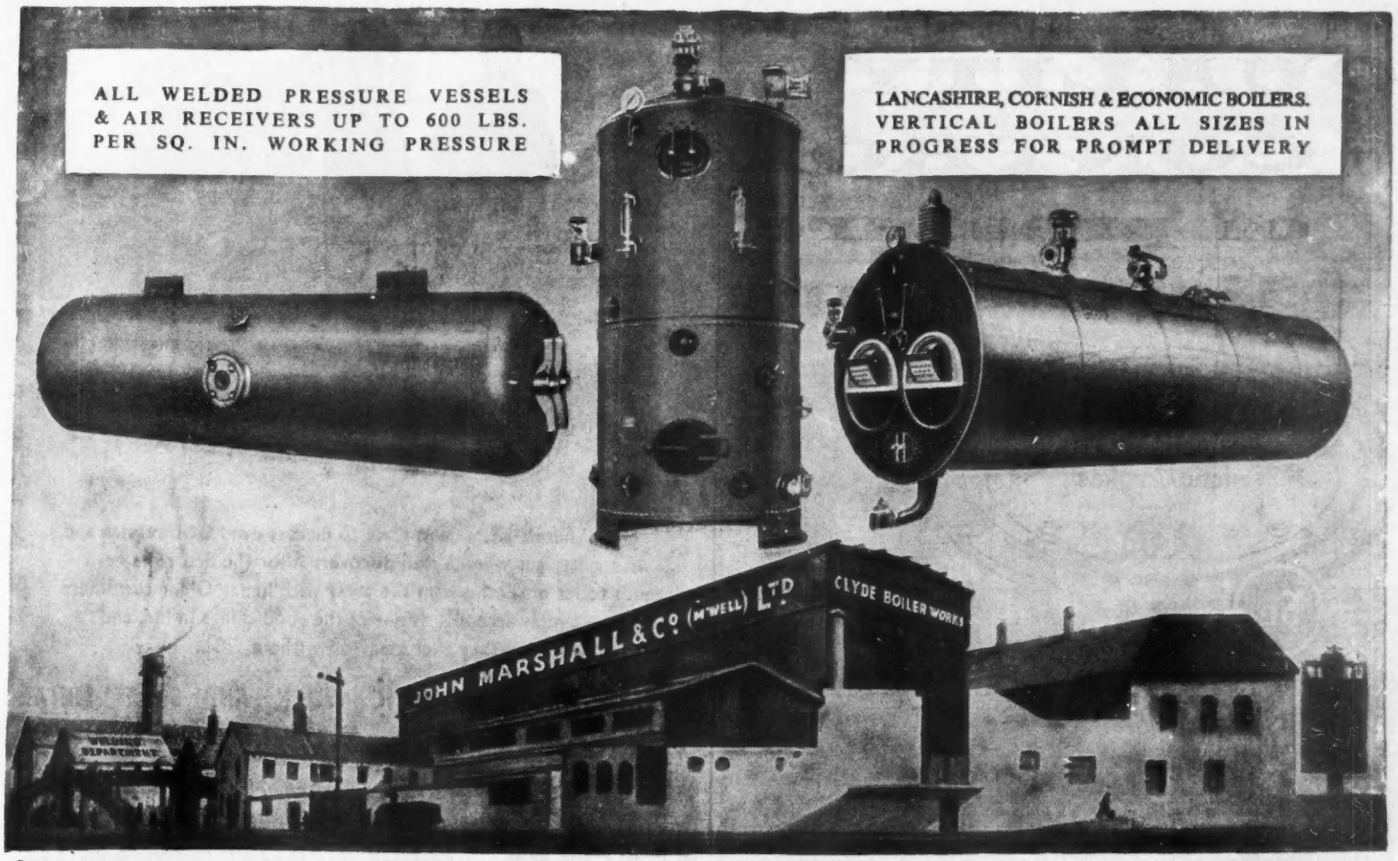
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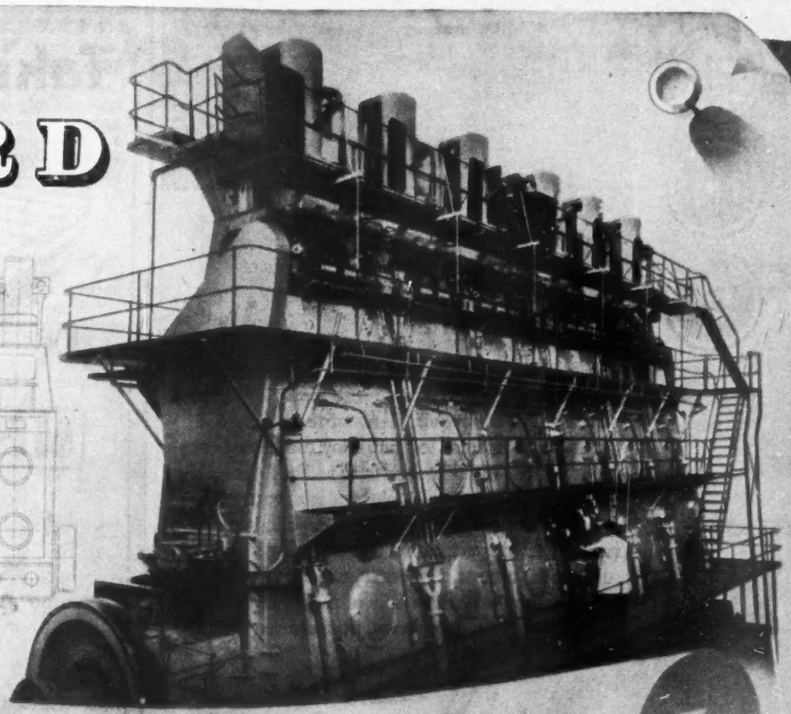

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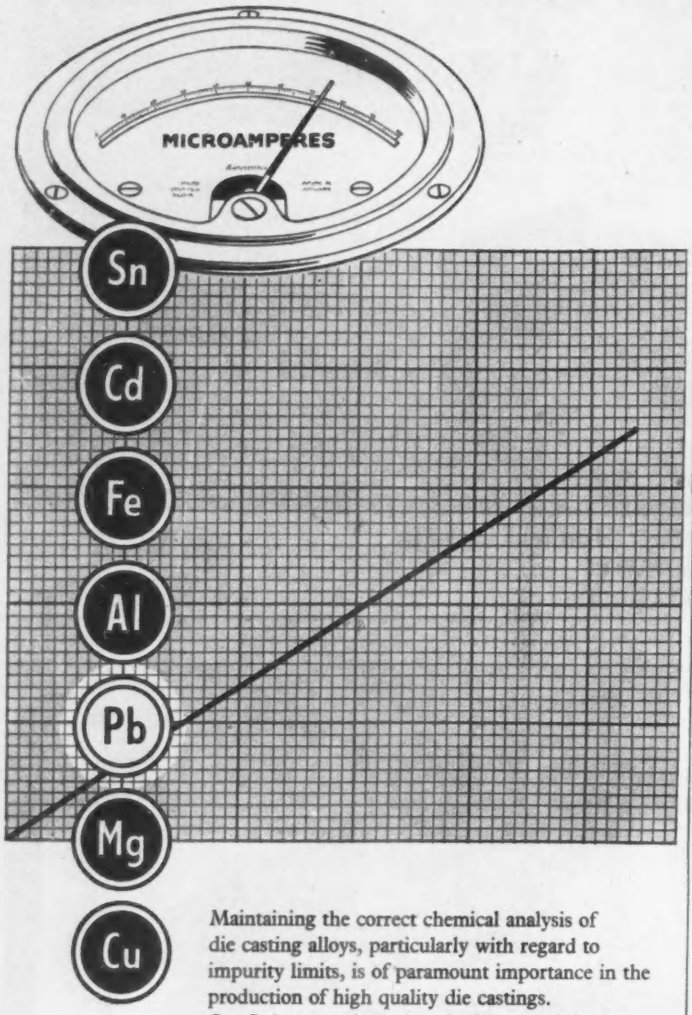

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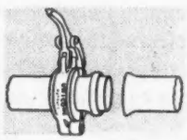
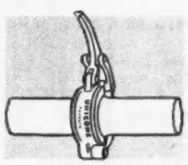
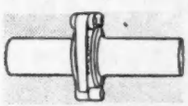


Rubber gasket in position and joint ready to pull over.



Pipe ends joined ready for locking.



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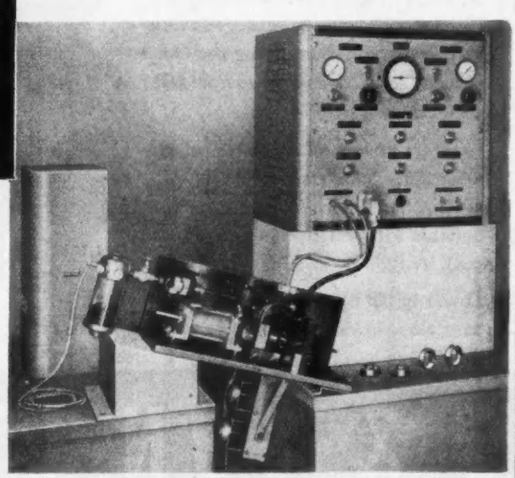

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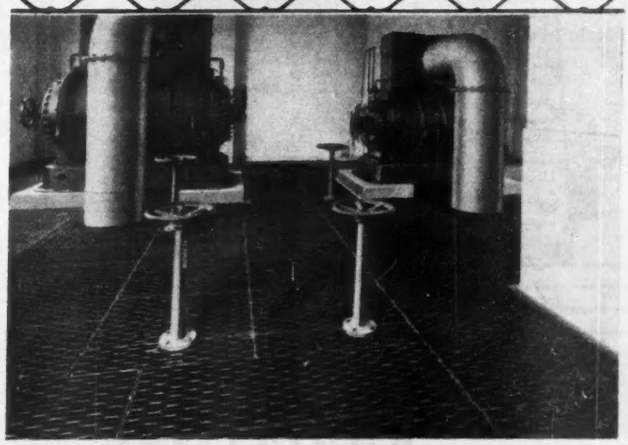
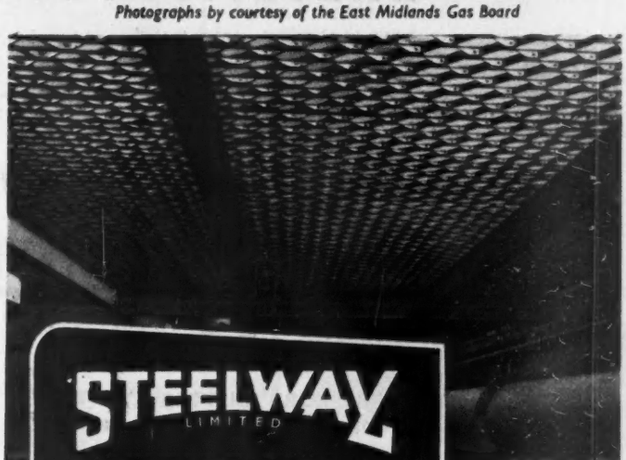


Photographs by courtesy of the East Midlands Gas Board



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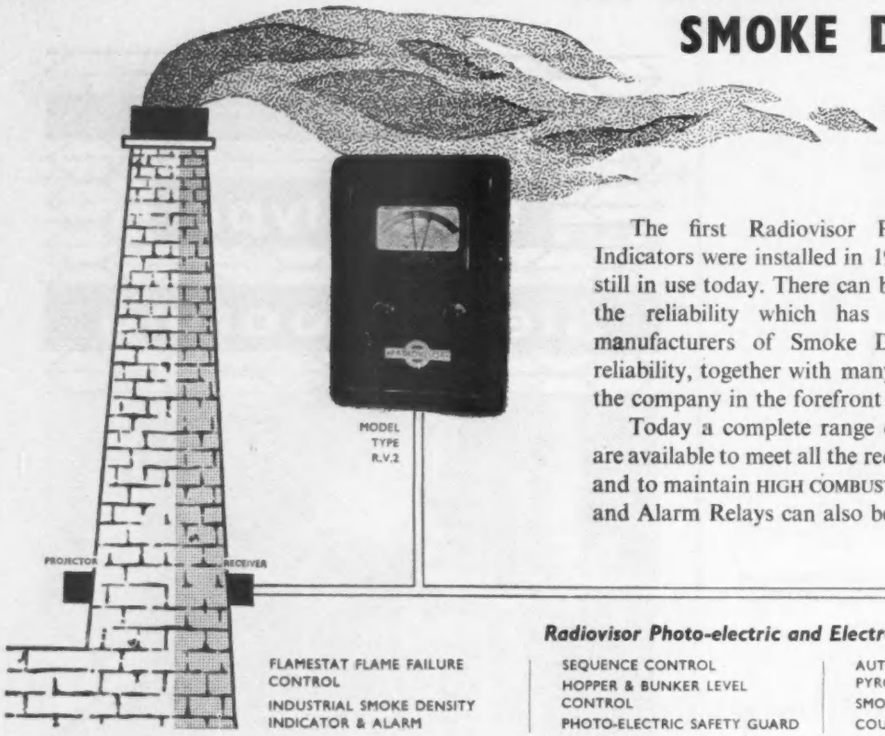

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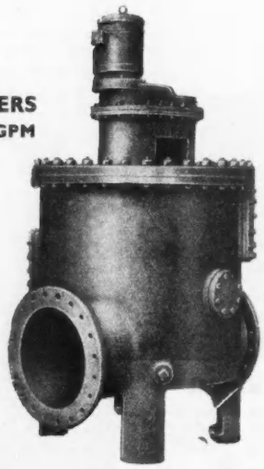

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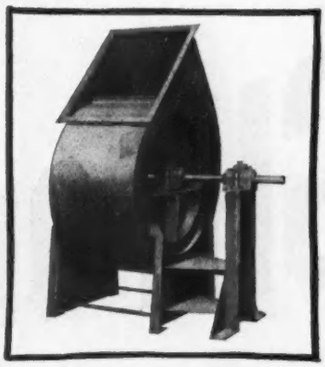

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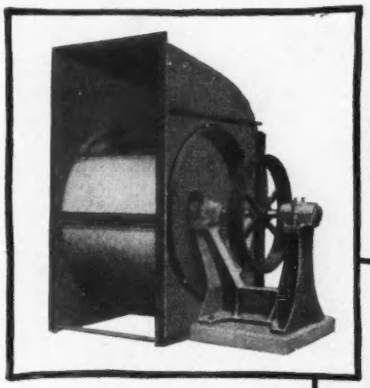
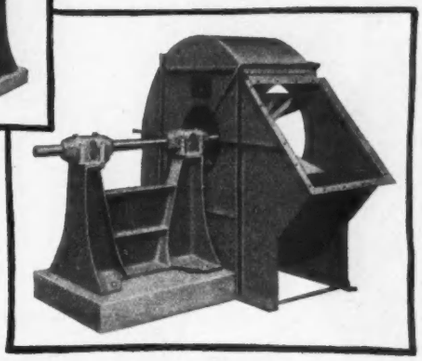


SLOW SPEED MULTIVANE FAN (Large size).

Air ways



PADDLE BLADE FAN.

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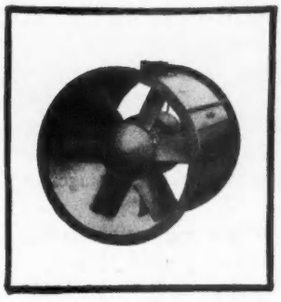
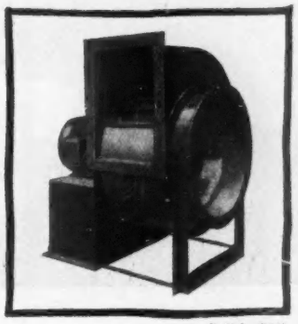
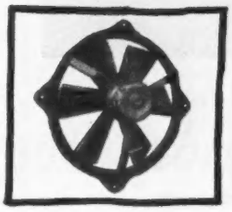


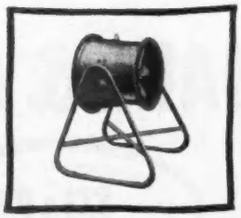
AXIAL FLOW FAN.



P.V.C. FAN.



PROPELLER FAN.



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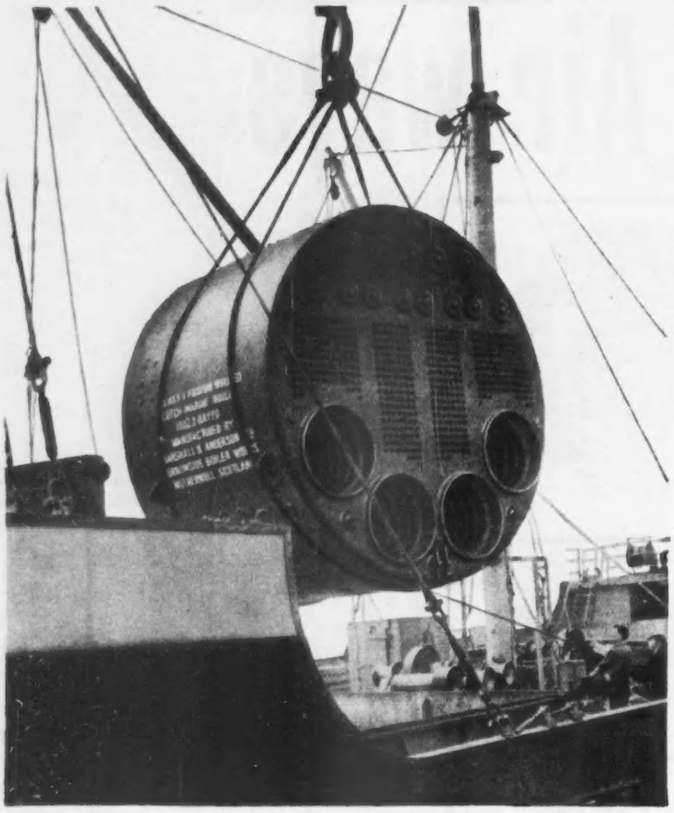

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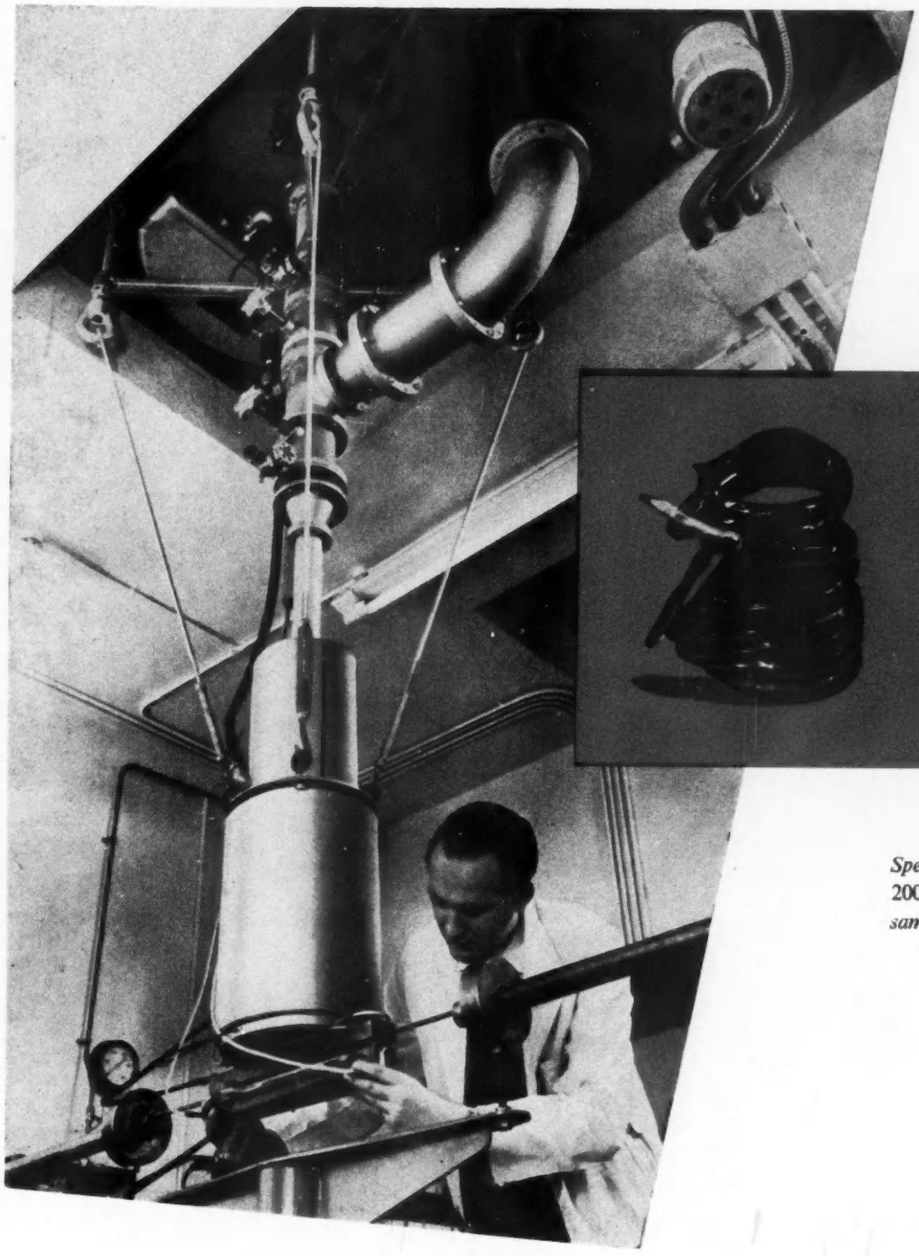
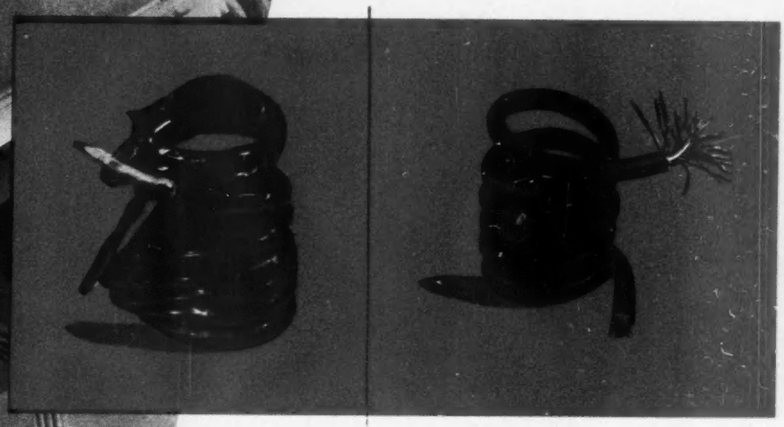


Setting up polythene core ready for irradiation.



Specimens of polythene cable after heating at 200°C. Left: Normal sample. Right: Irradiated sample.

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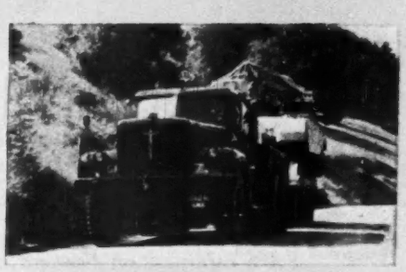
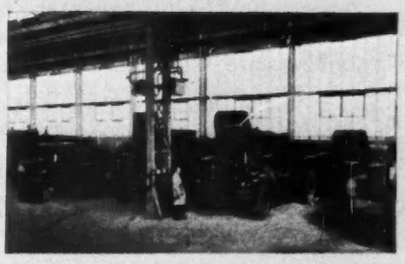
Yet another 'Atlantic' goes overseas!





Top illustration: Testing a 'Viscount' 6x6 military type chassis. *Middle*: An 'Atlantic' tractor in Switzerland. *Bottom*: A Rotinoff assembly bay at the Colnbrook factory.

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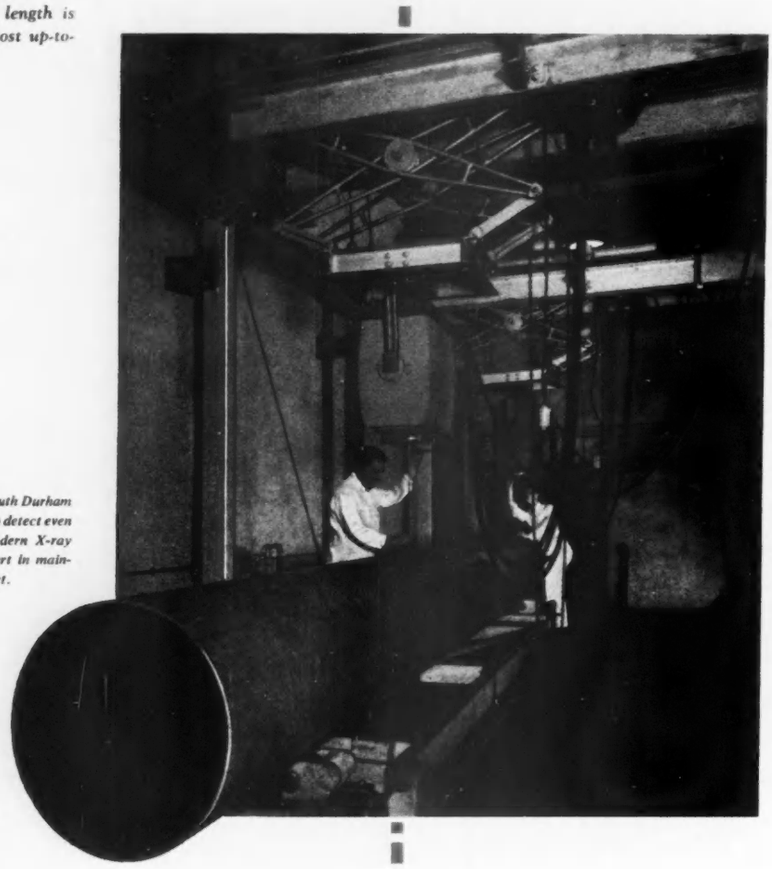

Right: The X-ray room at the South Durham pipe mill. Because of its ability to detect even the smallest flaw in welding, modern X-ray equipment plays an important part in maintaining the quality of the product.

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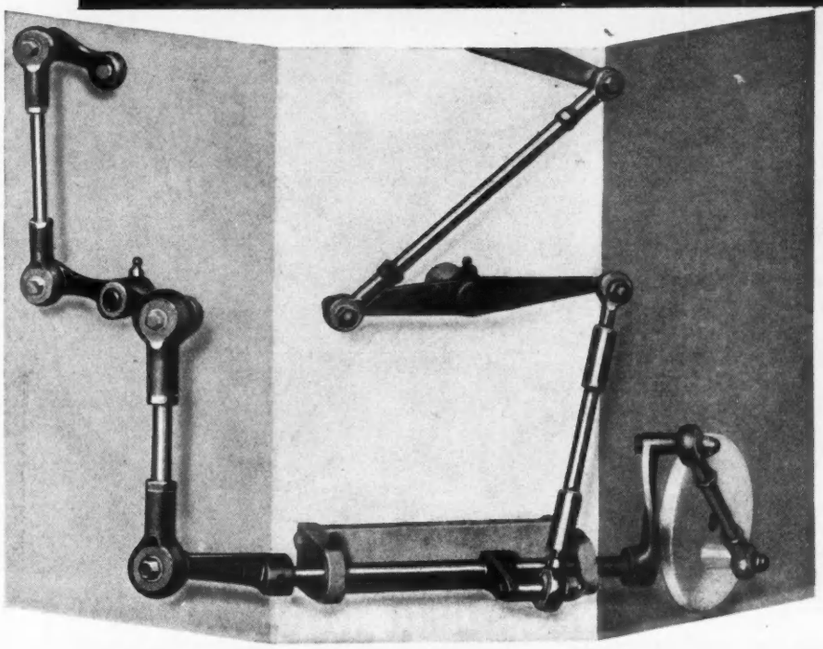

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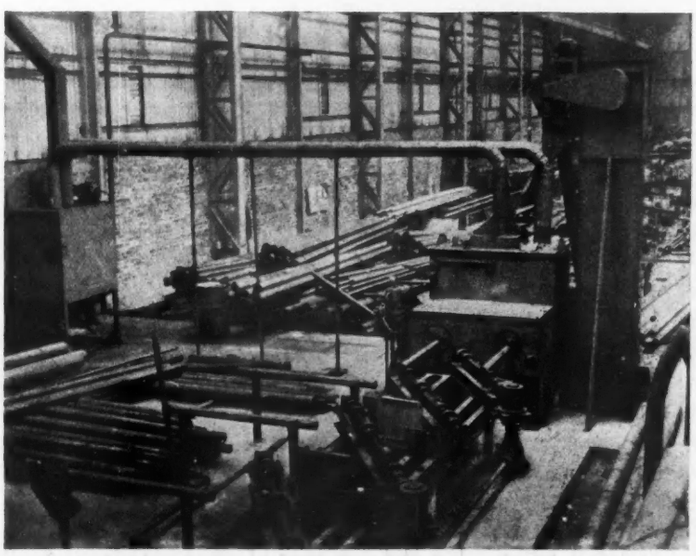

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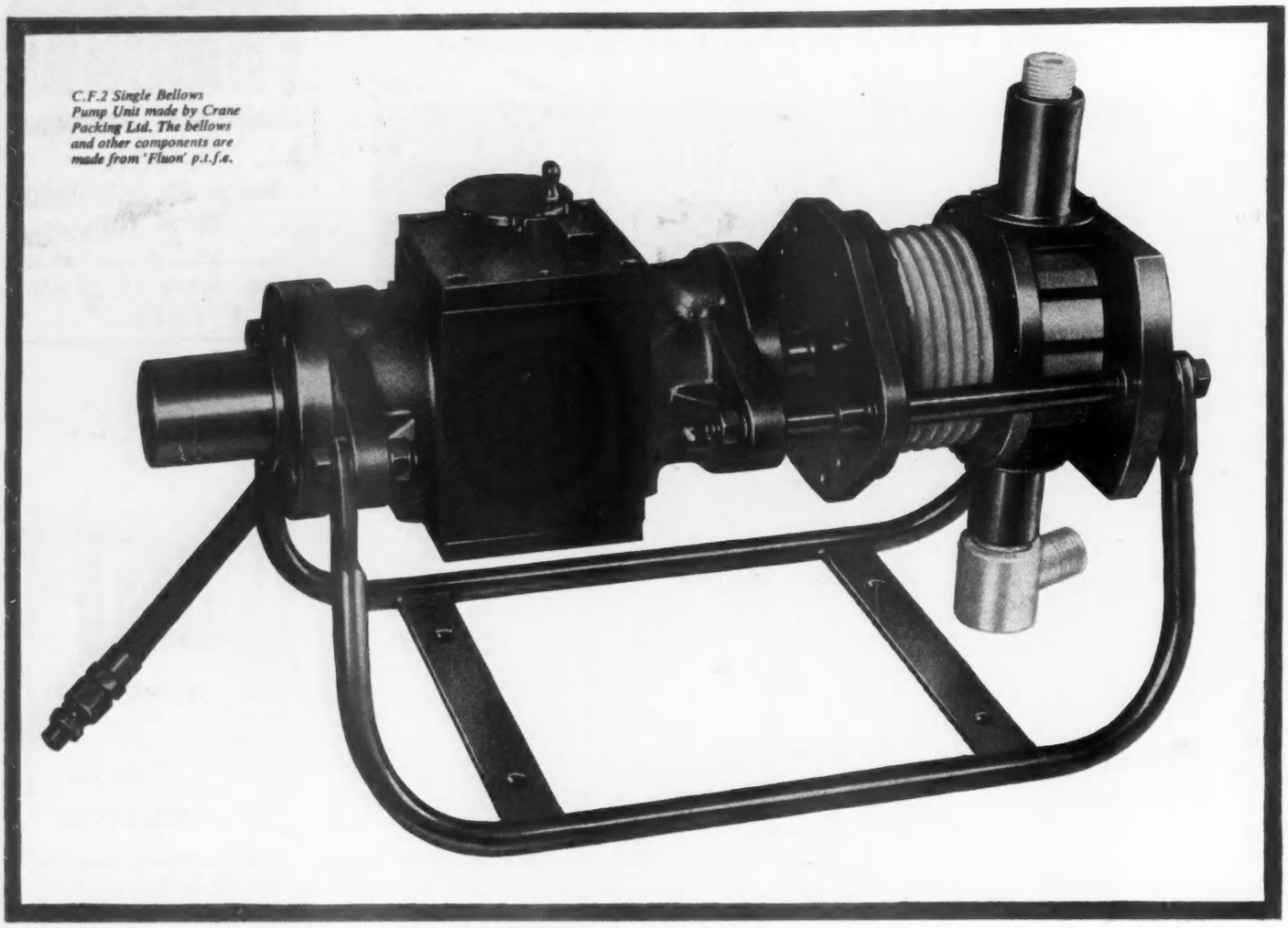

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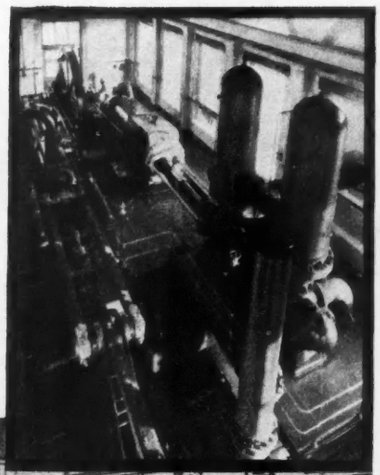

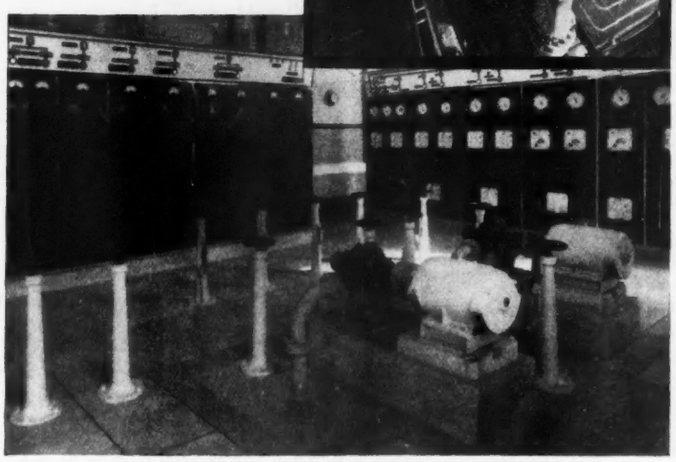

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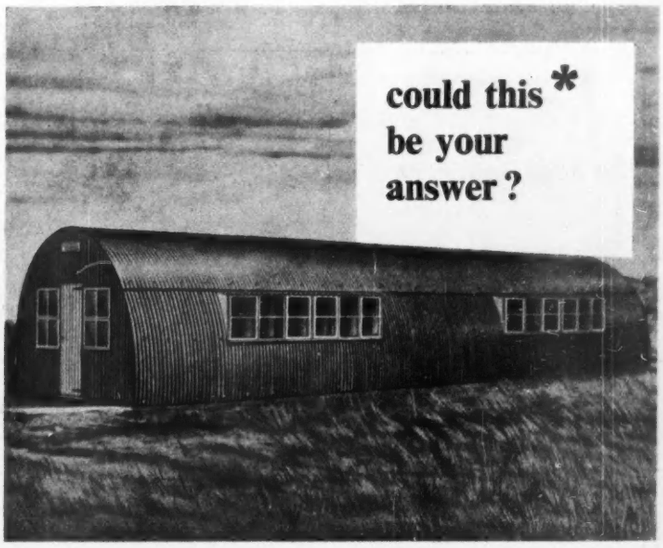

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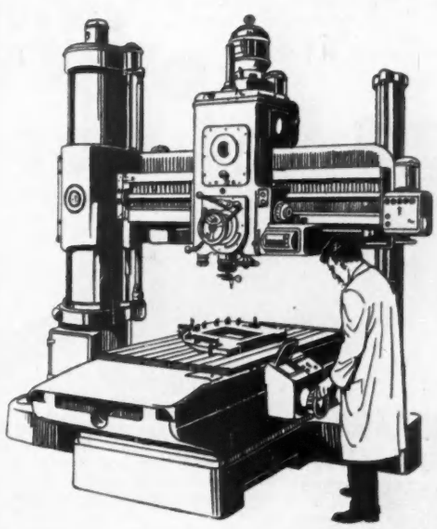

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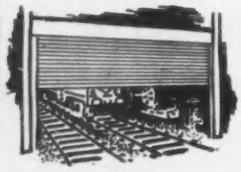

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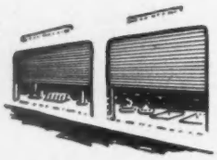

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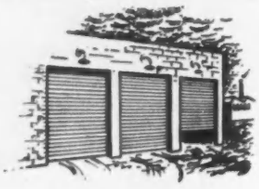

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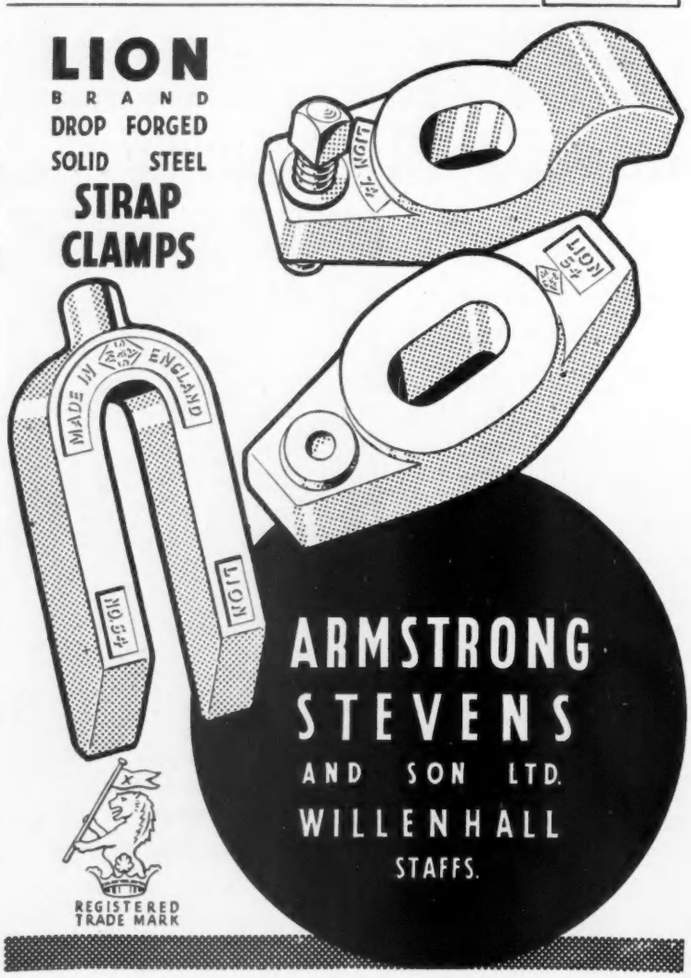

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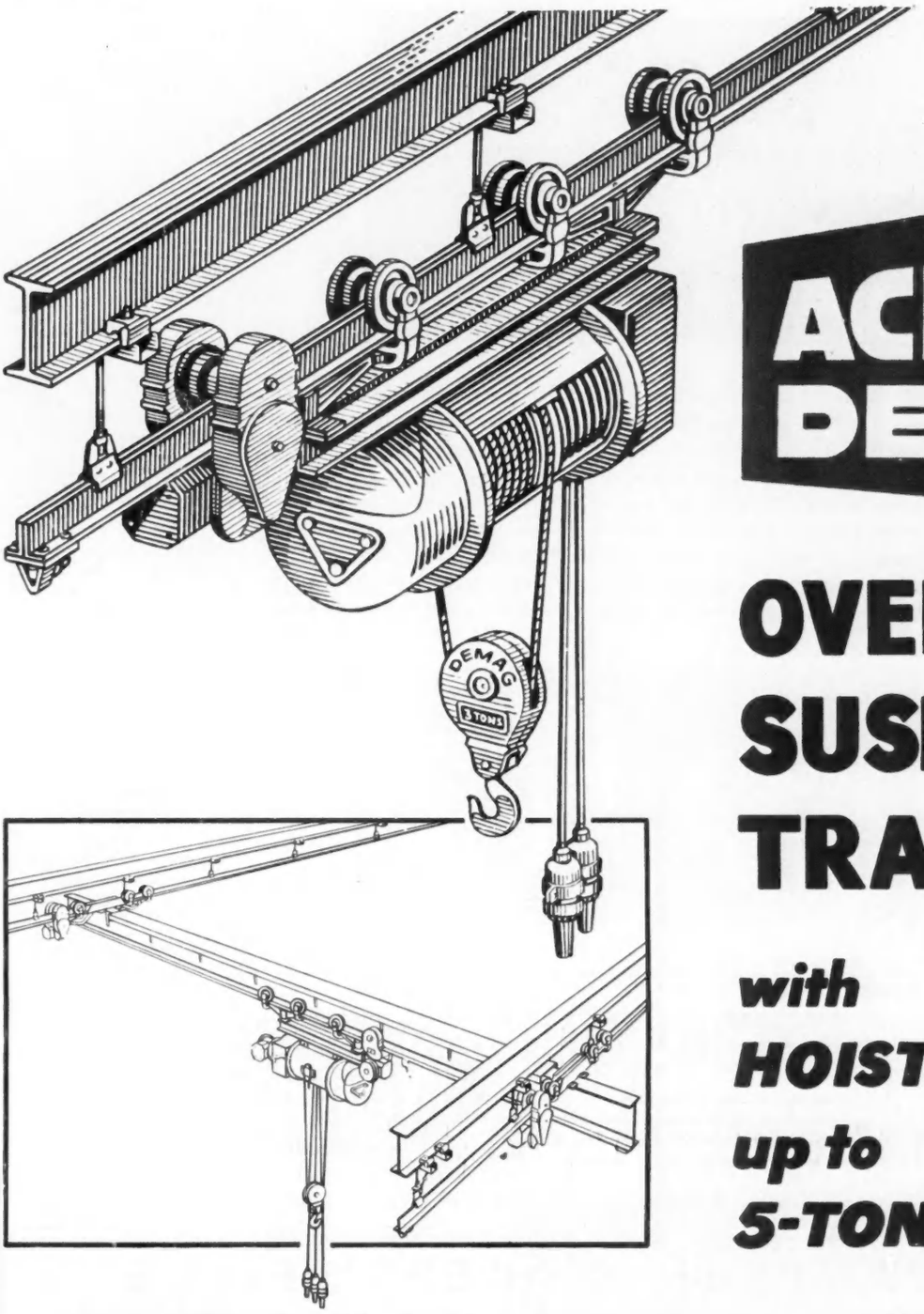

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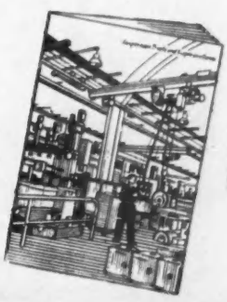

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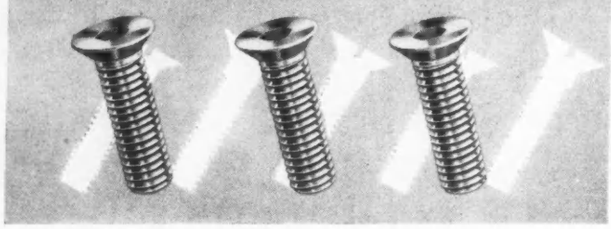
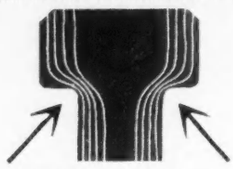
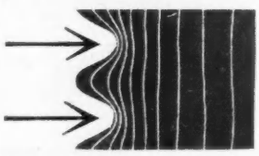


Calculating loads and stresses is increasingly important in modern screw design. Machines operate at higher speeds under heavier loads, materials are subjected to greater stresses. Screws are required to do more and better work.



Failure due to repeated stresses on a bolt are located at the point of higher stress concentration. These points are usually the head to shank junction or the threaded section.



With Unbrako, fillets are used at these critical sections to reduce stress concentration and increase fatigue strength, fillets under the head and at the root radius of the thread, carefully controlled for maximum strength.

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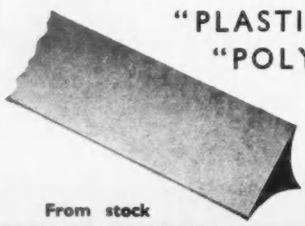

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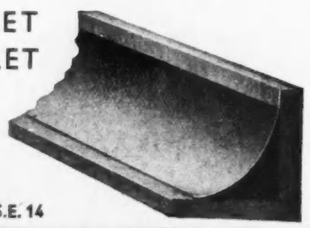

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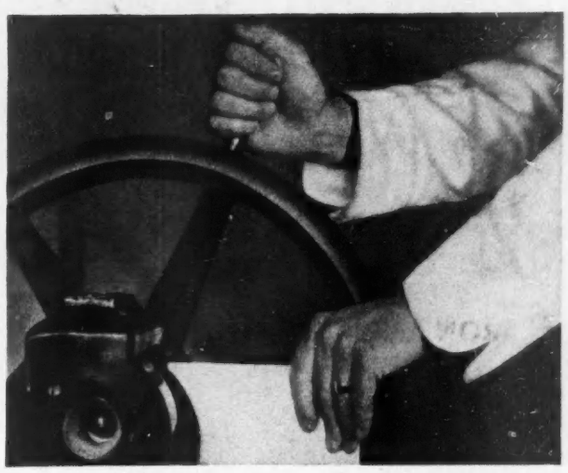

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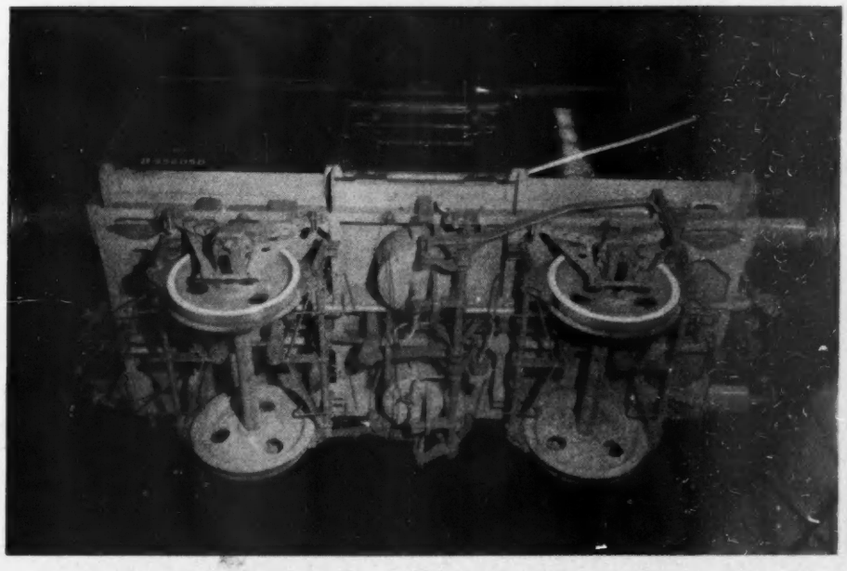

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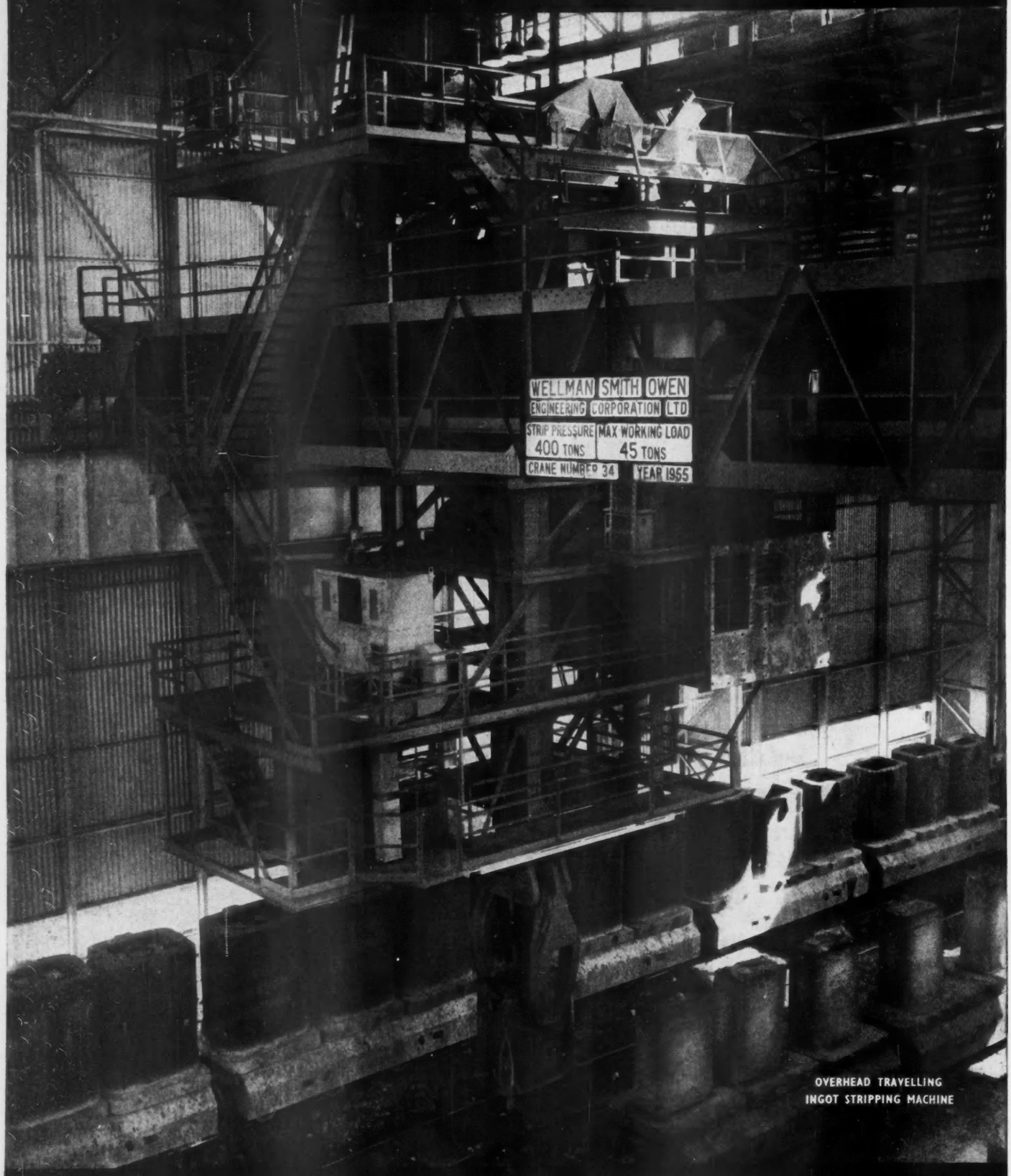

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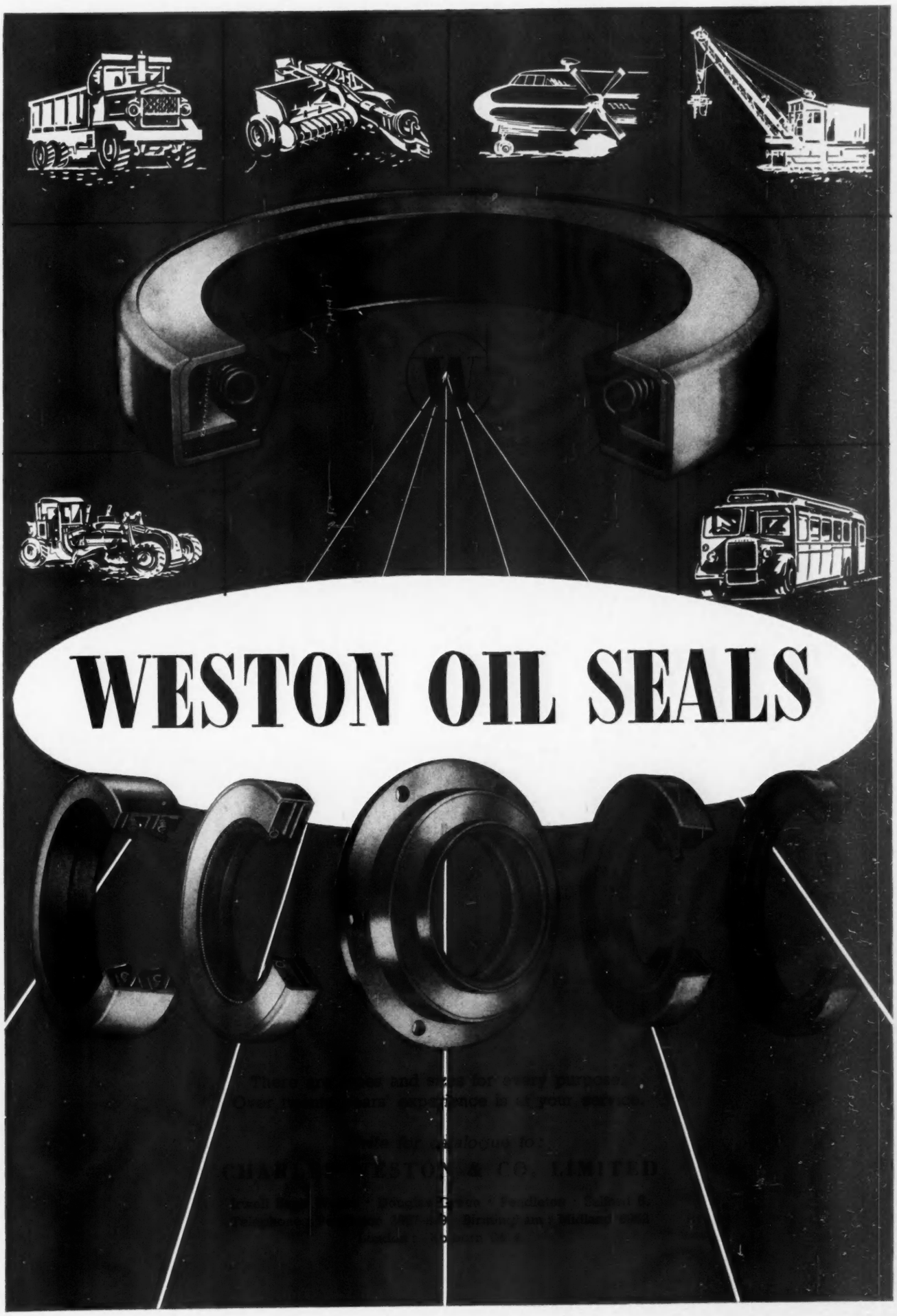
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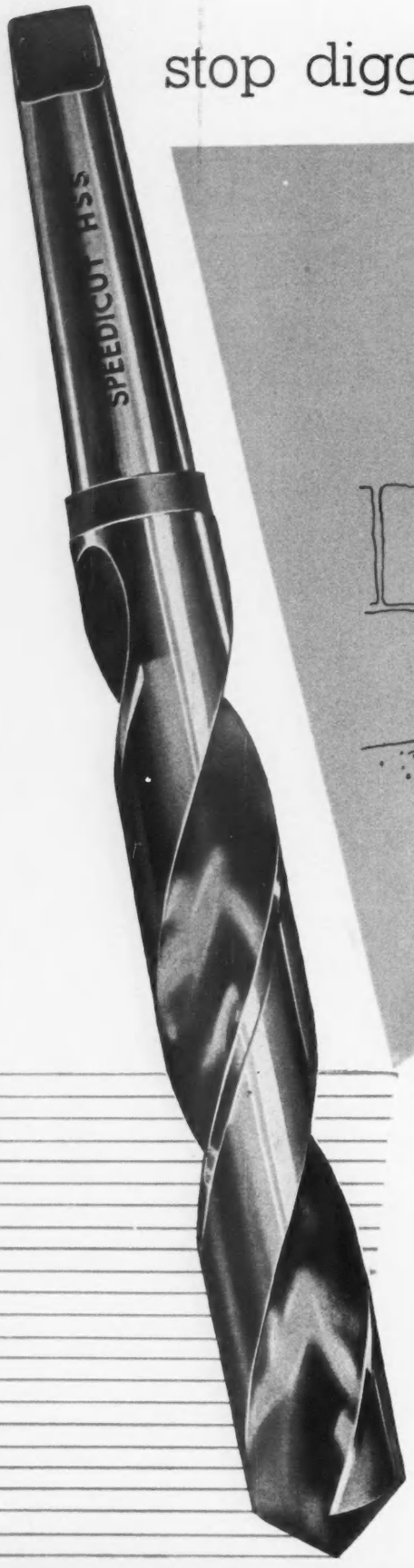
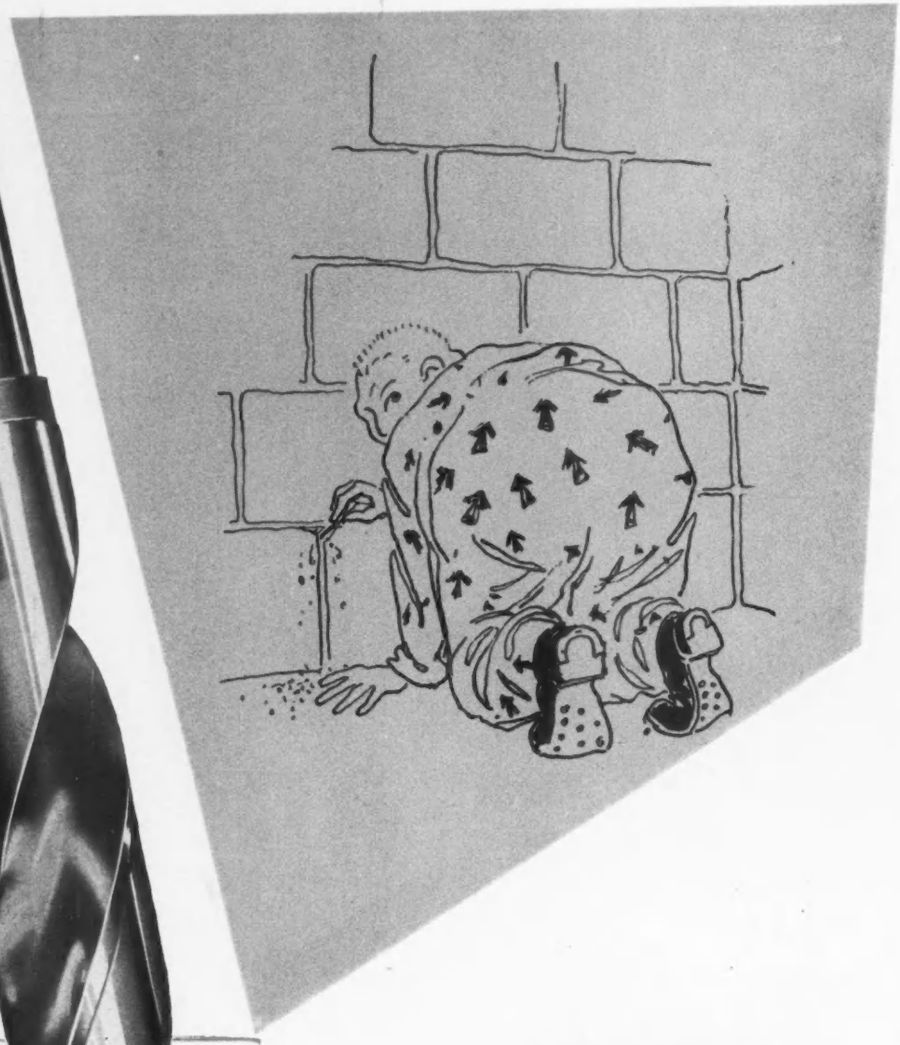
stop digging . . .





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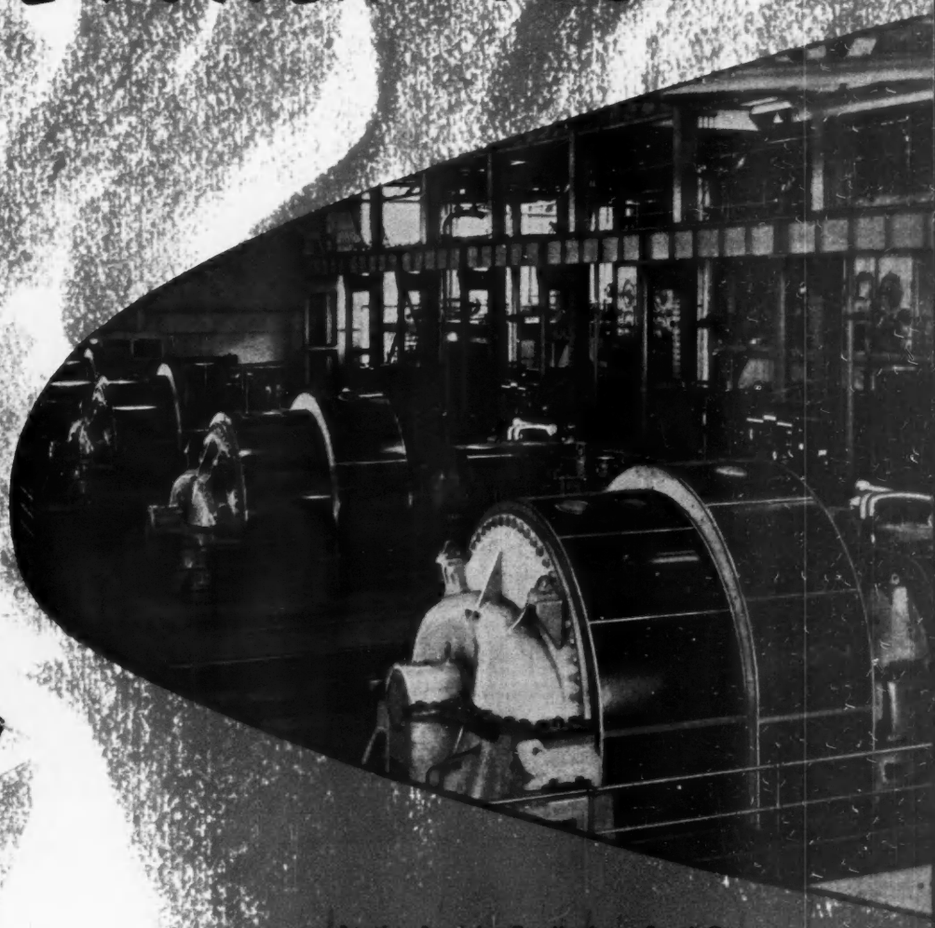

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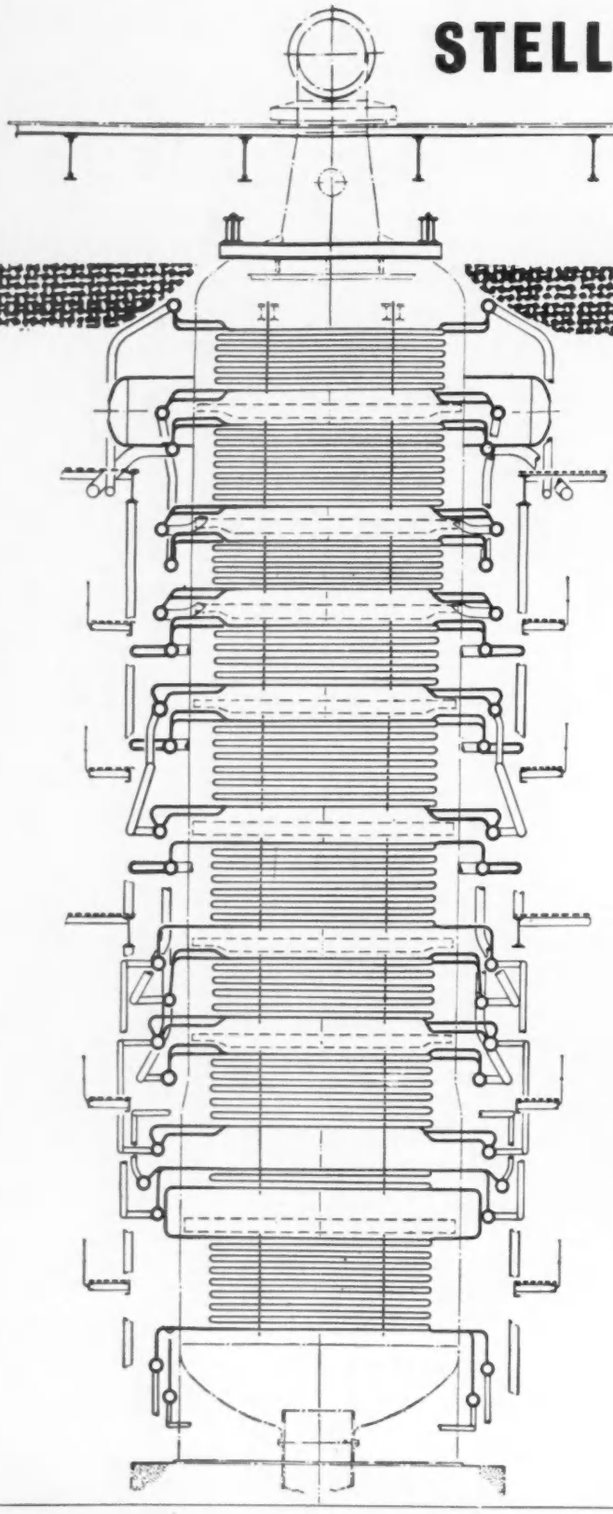

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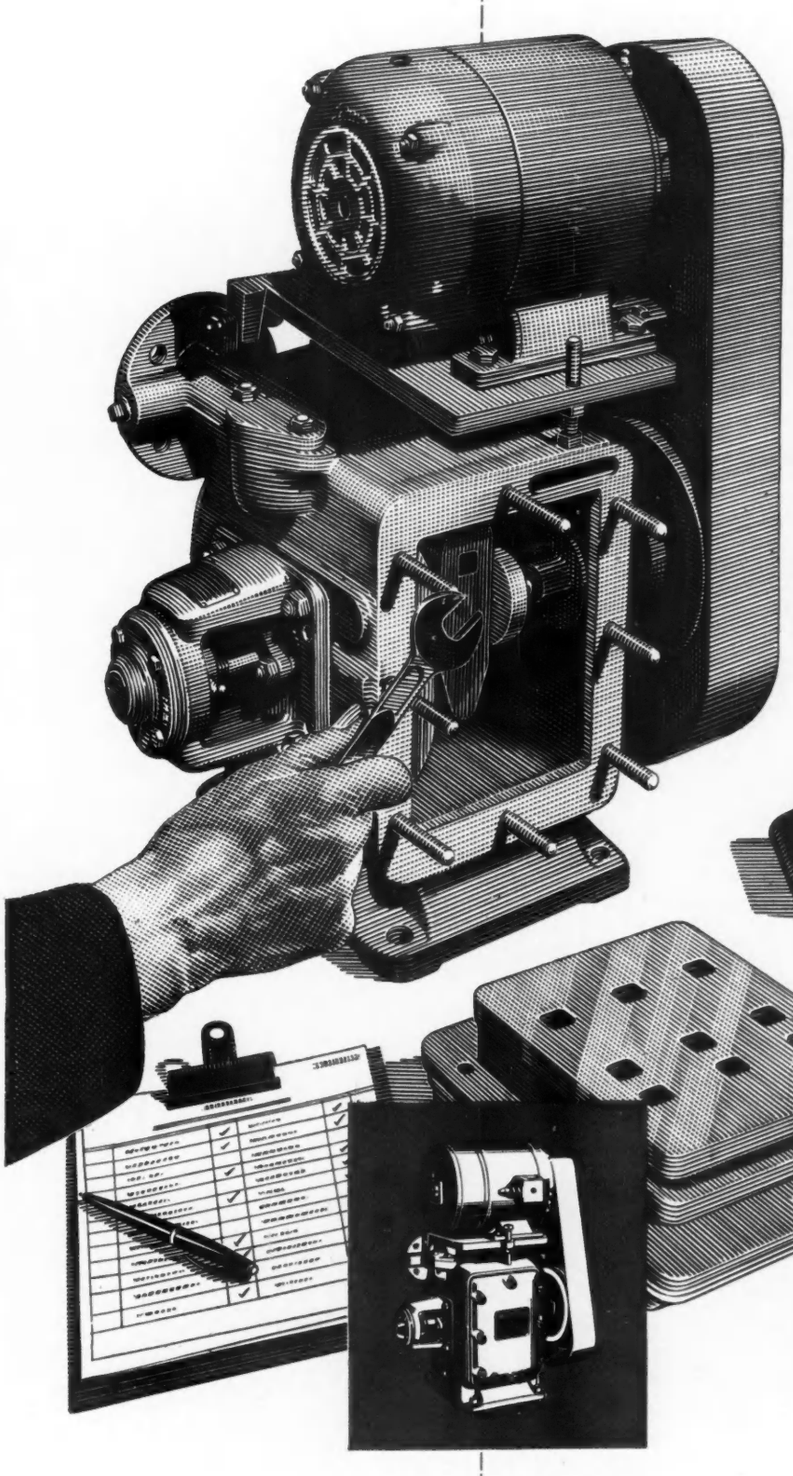
Summing up on the sliding-shoe pump



Self-priming, high suction lift, constant capacity at varying heads, self-compensation for wear, accessibility, supreme simplicity... As you tick off these points, you make the case for the MEGATOR sliding-shoe pump. The only moving parts are the rotor and the three rubber-lined plastic shoes.

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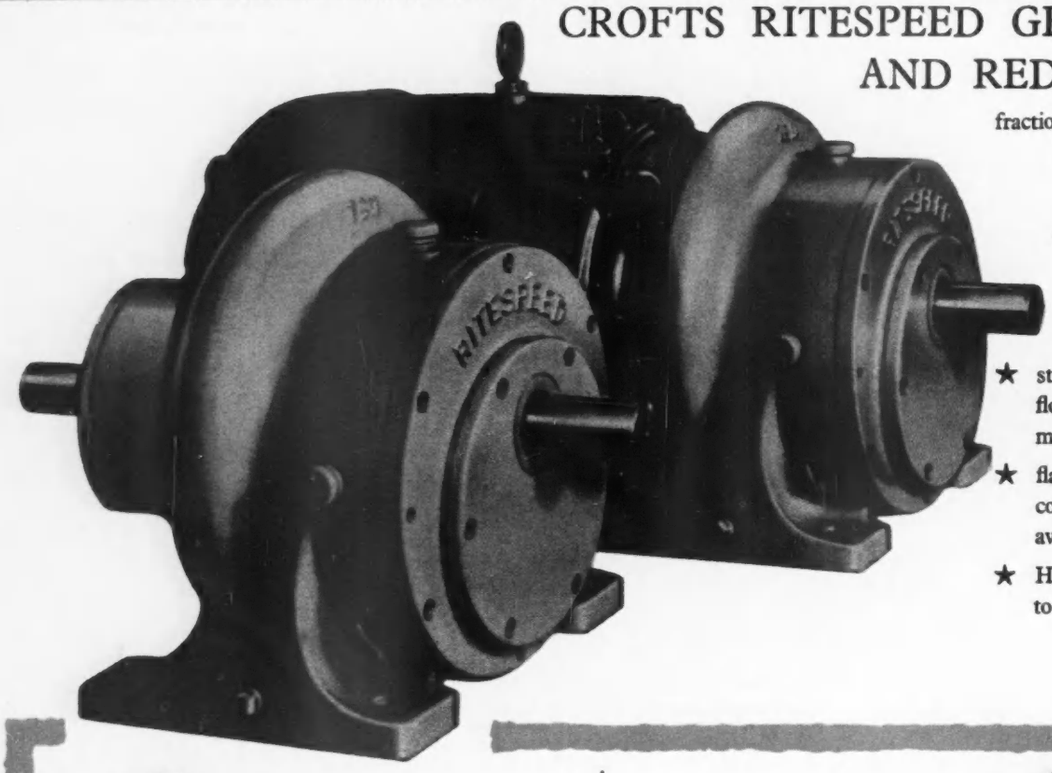

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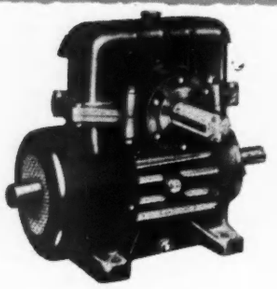

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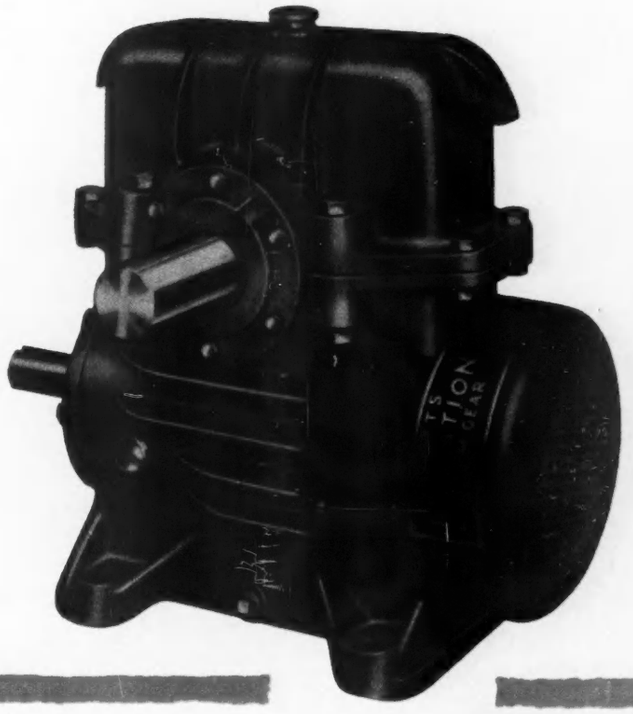

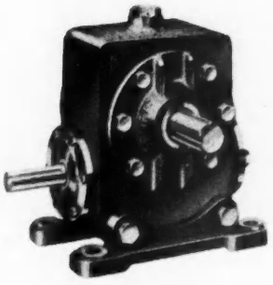

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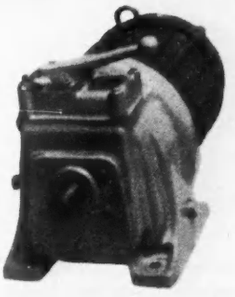

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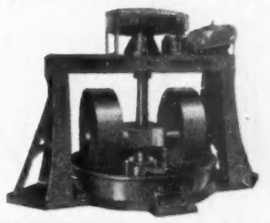

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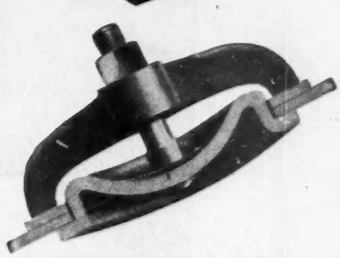

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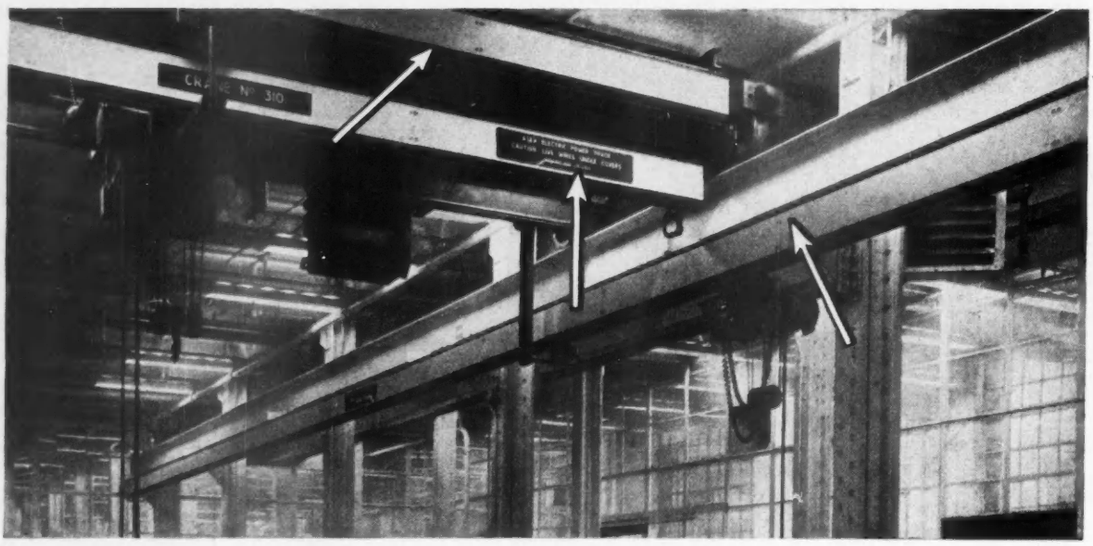

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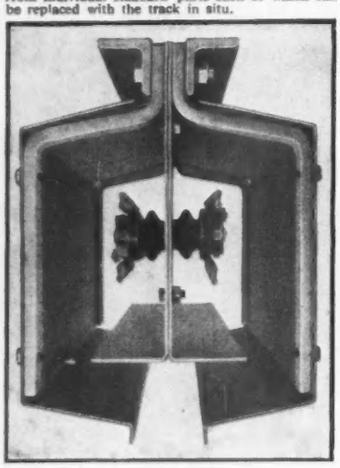

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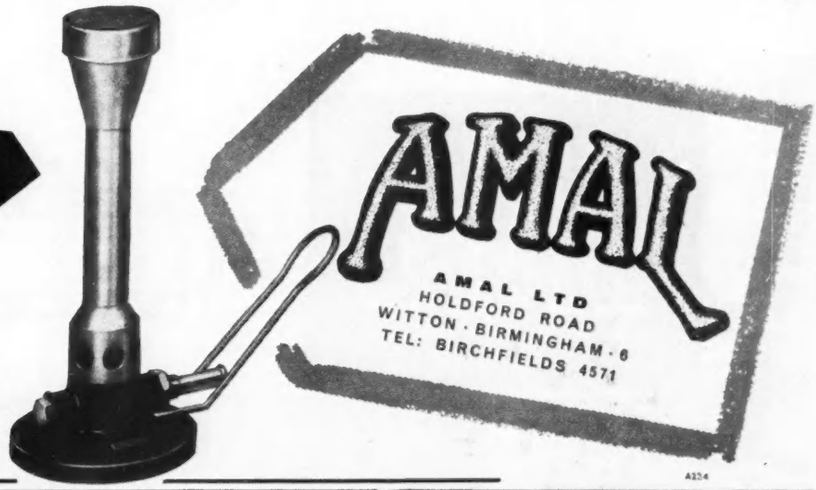

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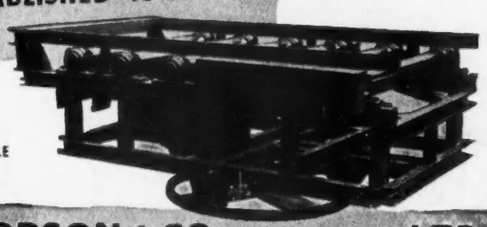

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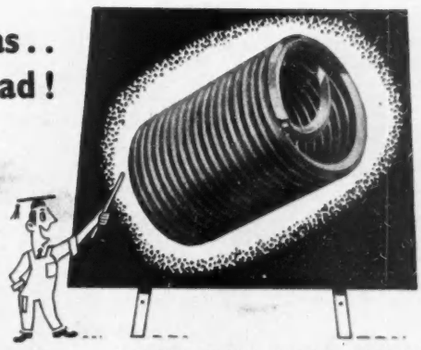

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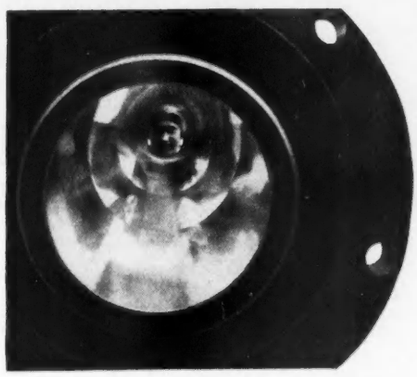

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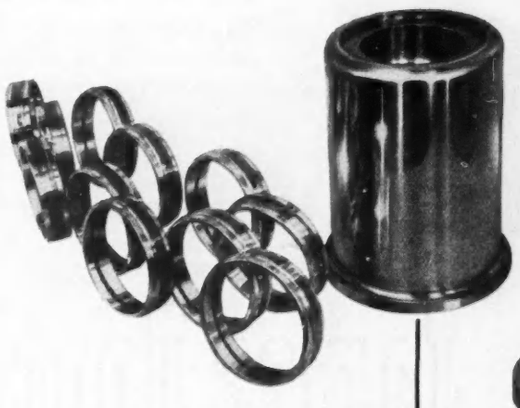
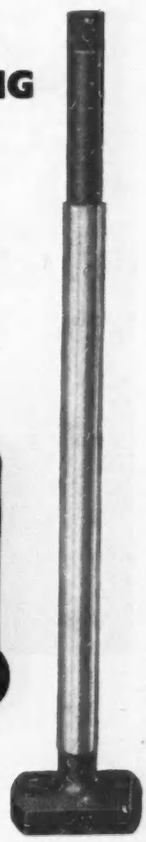


Capstan roller and spinning wheels: textile machinery parts "Monochromed" for greatly increased life.



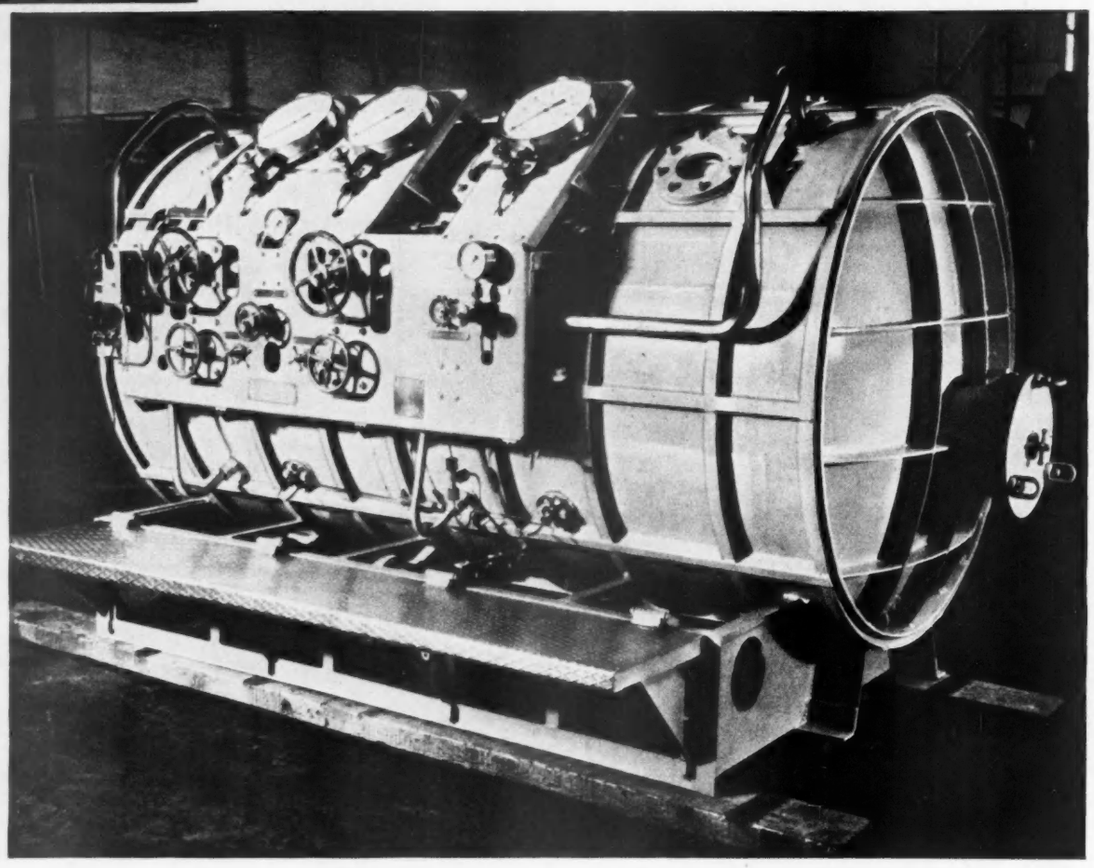
A "Monochromed" piston used in hydraulic equipment.

MONOCHROME LTD · STUDLEY ROAD · REDDITCH · WORCS · STUDLEY 121

'MG 5' REGD. TRADE MARK

VERSUS

'THE BENDS'



The 'MG5' recompression chamber is of all-welded construction and is pressure tested to 200 lb. per sq. inch. Seven men can be treated in its chamber and air locks enable patients to leave or enter the chamber while it is under pressure.

Special all-welded recompression chambers for the treatment of Admiralty divers are now being produced by Saunders-Roe (Anglesey) Limited, using James Booth's 'MG5' aluminium alloy. This is a new, important use for 'MG5' which is already accepted as a standard material for marine construction. Its unique combination of high strength, light weight and corrosion-resistance is of particular value in this application. The new 'MG5' units are considerably lighter than earlier Admiralty equipment making them more readily transportable and enabling fewer chambers to meet a wide range of conditions ashore and afloat. Their low weight is also a special advantage on board small craft.

Our Technical Sales Section is always ready to advise on the use of 'MG5' and other James Booth light alloys.

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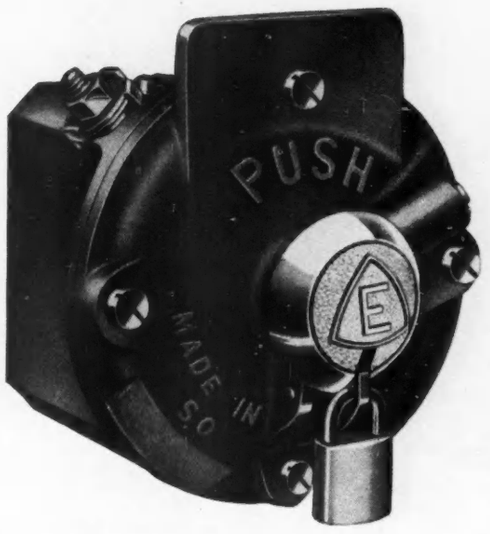
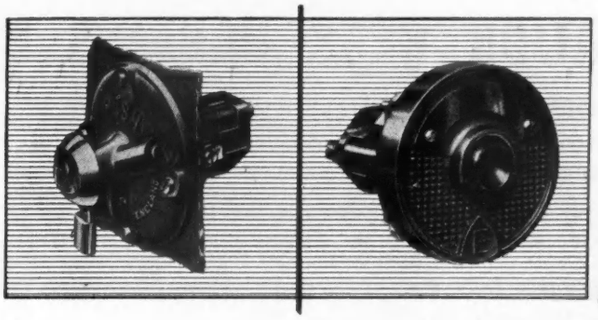
In an emergency, Ellison Push Switches can be relied upon to operate with ease and with certainty—even after standing idle for long periods. Exceptionally robust in construction, they are suitable for voltages of up to 660 and have a rating of 5 amps continuously.

Write for List No. 11 for details of "Ellison" trip switches and tappet operated limit switches for up to 150 amps.



MARK II SWITCH

For hand – or self – resetting. Contacts provide one normally open and one normally closed single-pole, double-break switches.



Left: **Panel Mounting Switch**

For hand – or self – resetting.
Contacts similar to the Mark II switch.

Right: **Panel Mounting (Self-resetting) Switch**

Contacts similar to the Mark II operated by a shrouded self-resetting push button.

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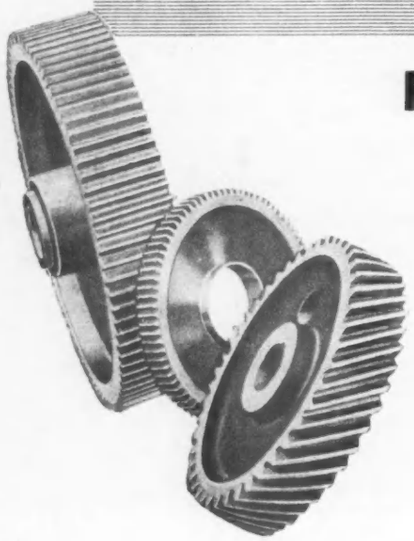
PRODUCTION GEAR HOBBING MACHINE



Largest in our range of automatic hobbing machines, the PH30 is characterised by its massive construction, thus eliminating any possibility of vibration at the highest production rates. Of the moving table type, it is designed to meet modern high speed production techniques for a wide variety of spur and helical gears up to 30 inches diameter.

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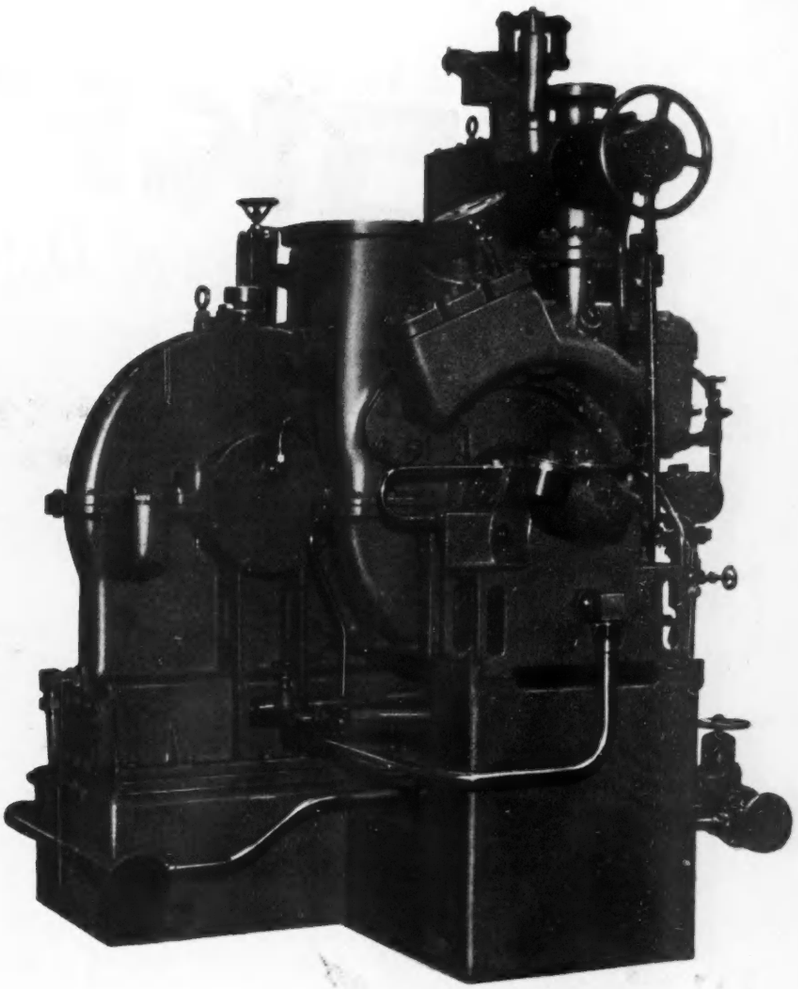

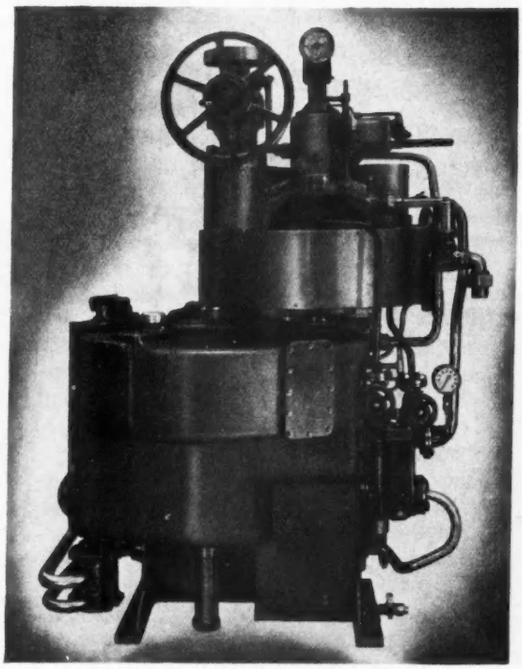

are available in horizontal or vertical designs for driving fans, pumps, mills and similiar machinery. Oil free exhaust can be used for process work or for boiler feed heating.

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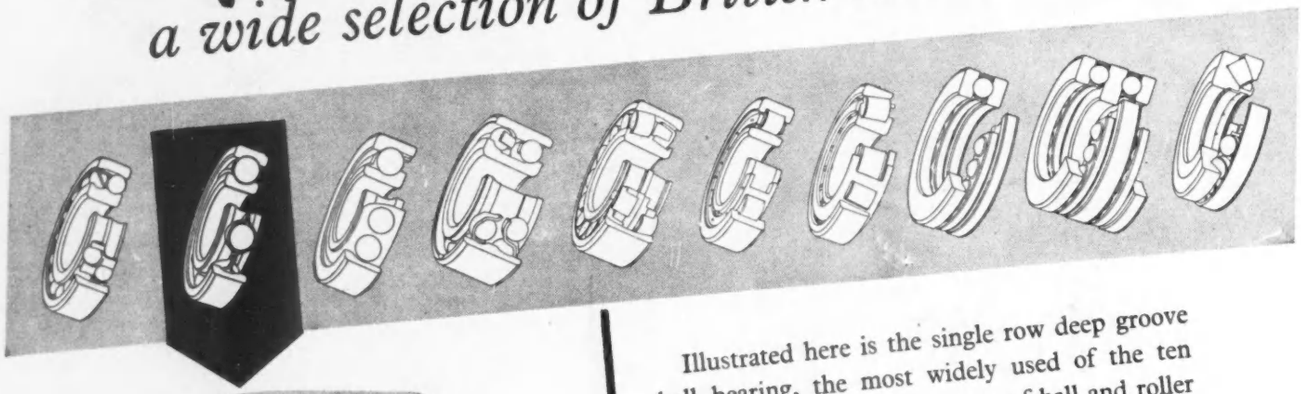
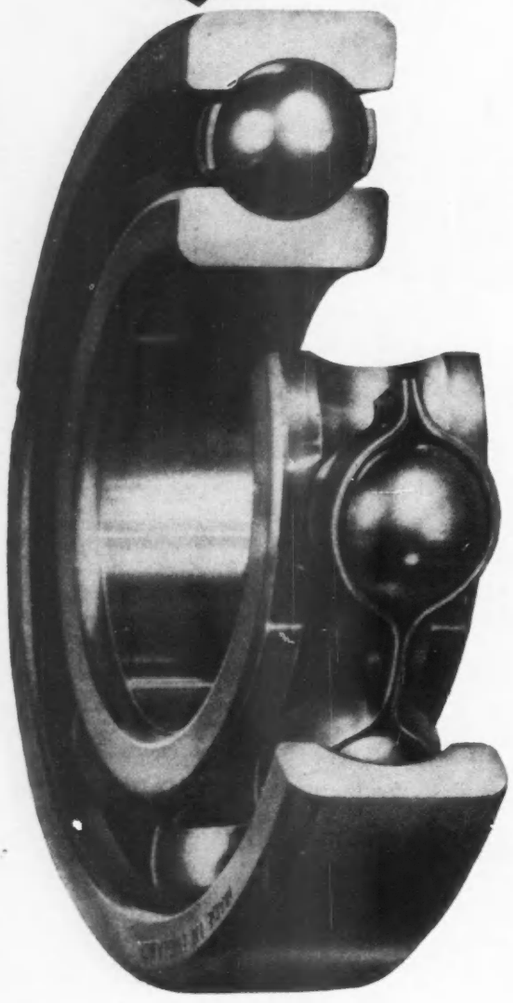
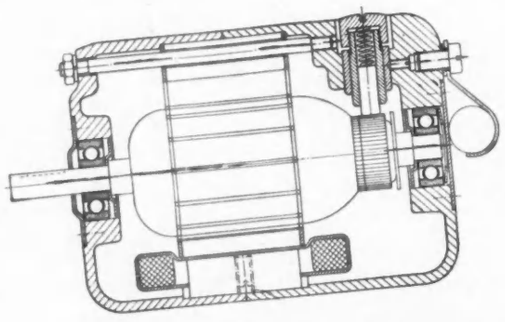




Illustrated here is the single row deep groove ball bearing, the most widely used of the ten variants of the four basic types of ball and roller bearing made by The Skefko Ball Bearing Co. Ltd.

The groove depth, ball size, and high degree of conformity between balls and tracks enables SKF single row deep groove ball bearings to deal with considerable thrust loads in addition to radial loads even at very high speeds.

A unique fund of technical information and experience lies behind the design of every SKF bearing—experience which is freely available to you whenever you have a bearing problem.



Bearing scheme for a small fan motor incorporating two single row deep groove ball bearings.

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THE ENGINEER

JANUARY 10, 1958

No. 5320 Editorial Contents now face inside front cover VOL. 205

PREVENT RATHER THAN CURE

In the introduction to the *Report on Heavy-Oil Engine Working Costs and Performance* 1956-57 compiled by the Working Costs Committee of the Diesel Engineers and Users Association, strong emphasis is placed on the need for preventive maintenance, a theme which has now acquired—in machinery operation—an importance analogous to that long attached—in medical science—to preventive medicine. There is of course a fundamental difference between the one and the other, the human machine possessing that precious faculty of self-recuperation which is lacking in the mechanical machine. Nevertheless, the engineer responsible for engine maintenance, even if he does not recall the proverbial saying that " Prevention is better than cure," can learn from the physician, who, since the time of Hippocrates, has been building up preventive medicine by " industrious investigation of the history of diseases, and of the effect of remedies, as shown by the only true teacher—experience." The key word here is " experience " and in the Report now before us we find—among others—a simple and conclusive illustration of its influence : It had been the experience in the power station at Gibraltar that trouble with engine governors ceased when governor springs were renewed after being in use for 8000 hours. " This," comments the engineer, " is a well worth while use of preventive maintenance in keeping pace with the fatigue of the springs " and the chairman of the D.E.U.A. Working Costs Committee, referring to this particular subject, remarks " The successful issue of any engineering project depends on preventive practice in all phases from the initial conception to the final usage of the product."

Perusal of the section of the Report entitled " Notes and Comments Received from Members " affords strong confirmation of the truth of the remark above quoted and any one reading the forty contributions from power station engineers in all parts of the world will be sensible not only of the valuable service rendered by these engineers to their brethren elsewhere, but of the need for designers and builders of oil engines as well as manufacturers of accessories to take careful note of the information and suggestions so generously made available. Very helpful, in this connection, is the provision in the Report whereby readers can quickly trace some at least of the salient particulars of the engine equipment installed at the various undertakings referred to in the "Notes and Comments." The attentive reader will surely agree that " The wide range of usage covered by the returns make it possible for almost any engine user, or prospective user, to make valuable comparisons or estimates with his own usage or prospective use." Certainly the study of these returns lends force to the suggestion that preventive maintenance should be supported by preventive design, preventive construction and preventive planning. In making this suggestion the chairman of the Working Costs Committee recommends that the idea of prevention " should be instilled into every embryo engineer during the formative period of his education, and into the mind of every craftsman and operator." Well would it be if this thought were earnestly propagated, using the word " preventive " in the sense of its Latin root, which signifies a going before. Examination of the " Notes and Comments " demonstrates not only the variety of causes to which failures can be attributed but the precautions which should be taken in order to prevent recurrence. For example if, as reported in one case, " cracking of piston crowns and frequent failures in big-end and main bearings " has been consequent upon " rapid choking of the radiator-type lubricating oil coolers " then here is something which, conveying a lesson to users, should be rendered non-recurring through action taken by the manufacturers of the engines and of the oil coolers. Another item which is the subject of more than one comment is the leakage past rubber sealing rings. Preventive maintenance at this point calls for withdrawal of cylinder liners and their refitting when the debris of ineffective sealing rings has been extracted and replacements fitted. We read with interest that the use of joint rings made from synthetic rubber appears to be lessening the incidence of this kind of leakage. There must be many engineers who agree—with the engineer of the Tanganyika Electric Supply Company—that heat exchangers will not give the same heat transfer under severe climatic conditions as in temperate climates. They will also be apt to agree that " the provision of additional capacity in the heat exchangers is the only remedy." This is a matter for preventive design since an inadequate heat exchanger can lead to damage from efforts—as by greater flow of water—to compensate for insufficient heat transmitting surface. In the example quoted the result of greater water flow was " higher pressures, erosion and leaking liner glands." In a case of complete bearing failure throughout an engine, it is explained that it was due to a blocked valve and the engineer calls attention to the need to ensure that " the foot-valves of lubricating oil pumps should be made easily accessible for regular inspection. In some designs the valves are far too difficult to inspect and so are liable to be neglected. In this case a faulty pressure gauge and the lack of an automatic shut-down device at a remote place has proved expensive, and demonstrates that such devices are a necessity, especially with semi-skilled labour."

In publishing its Reports on Working Costs the Diesel Engineers and Users Association performs a valuable service alike to engine users and engine manufacturers. It is a sort of technical literature which, intensely practical, merits the widest circulation and cannot but be helpful to all who study it. We are moved to suggest here that what applies to mechanics can apply

also to economics. It has indeed, been laid down by an American writer that " We must think of our whole economics in terms of a preventive pathology rather than a curative pathology."

DIESEL LOCOMOTIVES IN AMERICA

At the present time when the British Transport Commission is committed to a complete change in the basic motive power of the railways in this country there is much to be gained from the experience of others who have ventured upon similar paths. On this account a paper by Mr. H. G. McClean, " American Experience as a Guide to Main-Line Diesel Locomotive Applications Overseas," presented to the Institution of Locomotive Engineers on Wednesday, December 18, is both opportune and invaluable. In one respect the railway wheel has come full circle. We in this country pioneered the construction of railways, and the operation of them by steam locomotives. Other countries, notably the United States, were able to profit from our early experiences, and to build in such a way as to avoid features that have hamstrung development, notably in the restrictions imposed by the loading gauge in this country. Now, the American railways have preceded us by some ten to fifteen years in a change over to diesel locomotion phenomenal in its rapidity and completeness, and the opportunity is now open to take note of, and profit by, their experience. Mr. McClean is the export manager of the electro-motive division of the General Motors Corporation, and his paper is written to some extent from the viewpoint of a manufacturer ; but in telling the story of diesel locomotive development on the Class 1 railroads of the United States, with a wealth of statistical detail, he presented a very interesting picture of the railroads themselves. Mr. McClean was not able to read his paper in person, but his commentary, accompanied by a series of beautiful coloured slides, was " put across " by Mr. A. W. Manser, chief mechanical engineer of London Transport.

The paper emphasised the importance of what are called " application studies." At first, diesel locomotives were introduced on to one or two specific long distance passenger trains. They were attractive because the locomotives were assured of a high annual mileage, working on such duties as through runs from Chicago to the Pacific coast, with a turn round time of about ten hours at each terminal. The second phase of " dieselisation "—a horrible but useful word !—covered a stage by which more than half the traffic of the entire railway was involved. Mr. McClean records that between 300 and 400 detailed studies were made, in all of which the graphic timetable of the proposed diesel service was the centrepiece. Exact running times could be calculated upon data guaranteed by the locomotive manufacturers ; the locomotive rostering diagrams were prepared, and thus the number of locomotives required for a given traffic could be determined on a precise basis. With the experience gained from phases one and two the American railroads entered upon phase three, covering roughly 50 to 80 per cent dieselisation. In full confidence of the new power locomotive diagrams were planned to secure the complete utilisation of the available units, and Mr. McClean instanced the case of a high speed passenger train locomotive, which might have run 700 miles overnight, arriving at the terminus at 7.30 a.m., being used to make two quick round-trip suburban runs before going to the locomotive shed at 10 a.m. By the end of 1955 all Class 1 railroads in the United States were 90 per cent diesel, and at the present time application studies are in some cases being made by joint teams—part railway and part manufacturers' staff—aimed at the complete elimination of steam, and the utilisation of the diesel power to maximum advantage.

Similar aims have been announced in this country. One project is complete diesel working on the Western Region lines west of Newton Abbot. But a sentence may be quoted from Mr. McClean that emphasises the kind of problem that may well arise in South Devon and Cornwall. He says : " Such studies, of course, are complicated because of the variations in volume of traffic, either seasonally or year by year." " Variation " is a mild word to use in referring to some of the holiday traffic peaks experienced on British Railways, where on summer Saturdays in the height of the season the number of trains to be handled is often three or four times the normal volume run at mid-week. So far as the actual form of motive power is concerned it is interesting to observe that the general purpose locomotive is coming into favour in America to the extent of representing more than 70 per cent of the total orders on hand. From the outset multiple unit working has been extensively employed, and although there are now four manufacturers of diesel locomotives in the United States most basic models are not only similar in type but are all capable of operating in multiple unit with other makes. This latter is a facility that must be a great boon to the operators at times. In this country it is not only American experience that is now available. Our own manufacturers have fulfilled many orders for diesel locomotives of all kinds on overseas railways ; much first-class running experience has been gained, and will no doubt be put to good advantage in the execution of orders now on hand for the home railways. Although Mr. McClean's paper is aimed at overseas railways, and particularly those considering big diesel schemes, we have no doubt it will be most carefully studied on British Railways.

SCIENCE AND THE PUBLIC

Upon being elected President of the British Association for the Advancement of Science for 1958 Sir Alexander Fleck gave a short review of scientific developments in 1957, of which we reprint an extract on page 50. It is rather remarkable when reading his speech to note to what an extent engineers are contributing to scientific advances nowadays. There used to be a time when the division between scientists and engineers was well marked. Nowadays there is a broad borderland. For much of the work done by scientists has clear implications for engineers ; and much of the scientific work carried out by engineers has implications for scientists. In such fields the distinction between engineers and scientists has lost real meaning. Furthermore much that is done requires the co-operation of both scientists and engineers towards achieving a single object. One, for example, cannot put a Sputnik in an orbit above the earth's atmosphere to signal scientific information back to earth without calling upon engineers to design and make a suitable rocket ; and the engineers cannot design and make the rocket without a great deal of scientific information about propellants, heat transfer, the properties of liquids, gases and solids, and much else besides.

Sir Alexander also referred to the policy of the Association. The Association has become increasingly conscious that one of its more important tasks lies " in getting more and more people of these islands to realise the vital importance that science has for them." The council of the Association is to initiate two activities towards that end. First, area committees are to be set up, and secondly panels of speakers are to be gathered together.

The Committee will organise lectures, exhibitions and so on. The object of the activity was clearly brought out by Sir Alexander when he referred to an "essential characteristic" of the lecturers. They "should be able to put across science to general audiences and to young people." Our own reaction is immediately to ask to what extent engineers plan to take part in this British Association activity? For in our view it is even more important that engineering should be so "put across" to young people than that pure science should. In a rather muddled kind of way the public accords a high prestige to scientists. But there is a great amount of misconception about the work of engineers. Far too many people regard a professional engineer as some species of glorified mechanic. Very few have any real conception of the dependence of our modern civilised standards upon his work. Under the ægis of the British Association lecturers might well direct the attention of the public to the more scientific aspects of engineering work and the growing need within industry for young men of high mental capacity. One other question may be asked. The Science Museum in South Kensington could, if it set out to do so, make a much greater impact on the minds of lay visitors than it does at present. It needs in particular to impress upon visitors, much more than it does at present, how much they owe to science and engineering in their daily lives. Would not the British Association be doing a service if it impresssed upon the authorities the urgent need to expand the floor area of that Museum so that it could more effectively do that job ?

MR. THORNEYCROFT RESIGNS

It is very unfortunate that at a period when Government pronouncements have all been showing a firm resolve to fight inflation at home and to restore confidence in sterling abroad, Mr. Thorneycroft found it necessary to resign from the office of Chancellor of the Exchequer on January 6. For in the public mind his name, more than that of any other man, was indissolubly linked with the tough financial policies which the Government has followed since the international "run" on sterling in the autumn of last year. It seems to us far too soon to attempt to judge whether or not his resignation was really as essential as it seemed to him. Mr. Thorneycroft, no doubt with Cabinet approval, had laid down as a "principle" that estimates of Government expenditure for next year must not total a sum higher than that spent this year. In the event Cabinet Ministers proved unable to prune their estimates quite so far. The difference upon which the split came amounts, according to Mr. Macmillan, to less than 1 per cent of the total of current Government expenditure, something of the order of £50,000,000. That sum, under more normal circumstances, would clearly not have been large enough to have led to serious contention in the Cabinet. But Mr. Thorneycroft obviously felt that the resolution of the Government to stabilise the value of the pound and to fight inflation could not be made clear to the country and to the world at large unless the Government itself was prepared to accept the same stringent financial limitations that it was attempting to enforce upon industry; and that unless the resolution of the Government was made clear its policies could not become successful. He felt, in fact, that the matter at stake was one of principle. The real misfortune of the resignation is that whether or not the Government can, in fact, be held to be irresolute it has been made to look so. Mr. Heathcoat Amory has been appointed Chancellor in Mr. Thorneycroft's place.

AIRCRAFT PRODUCTION

There took place on Thursday and Friday last week, at the University of Southampton, the sixth annual conference on Problems of Aircraft Production, with the theme "U.S.—U.K. Practice," organised by the Southampton Section of the Institution of Production Engineers. There were four sessions, the first three devoted to the presentation of the following papers: "Manufacturing in the Aeronautic Age," by Boyd K. Bucey, "Manufacturing Practice—A Review of the British Aircraft Industry" by L. G. Burnard, A.F.R.Ae.S., M.I.Prod.E., and "Some Aspects of the Design, Development and Manufacture of the P.1 Wing" by F. Bradford, A.F.R.Ae.S. and G. H. Taylor. Mr. Bucey's was the Lord Sempill paper and was read under the chairmanship of the Rt. Hon. The Earl of Halsbury. The paper was supplemented by a colour film devoted to manufacturing techniques suitable for aircraft subject to kinetic heating. There were scenes of the spot welding of both skins to the corrugated core of a sandwich, using an expanding mandrel in the core, of routing with a carbide cutter cooled with expanding carbon dioxide, of titanium and high tensile steel being worked with hand drills and carefully sharpened bits, of "freeze chucking," delicate components being securely stuck on a refrigerated work table with water, and of the costly brazing of stainless steel honeycomb.

Despite the suggestions of prominent speakers at the last two conferences that papers be read in abstract only, very little time was allotted for discussion. Moreover, many of the questions raised were appropriate rather to papers read previously, such as that of A. W. Sheppard on Contour Etching (THE ENGINEER, January 18, 1957, page 98). The changing circumstances of the aircraft industry should demand changes in shop methods: the conference, if it is to continue annually, should surely be able to find material suitable for discussion rather than for the pages of a work of reference.

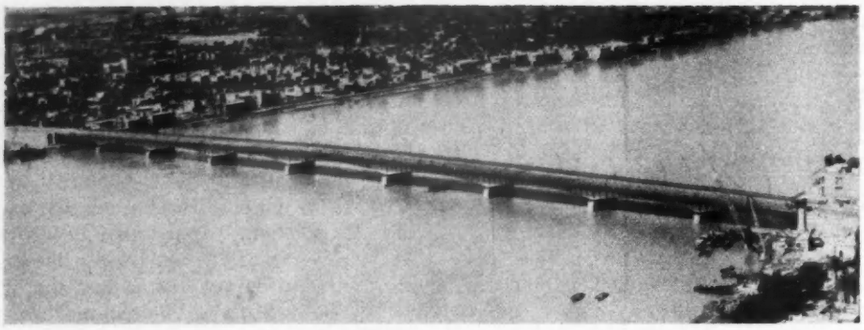
The Engineer — 100 Years Ago (JANUARY 8, 1858)

"THE LEVIATHAN"

"After a considerable delay, occasioned by an almost universal smash of everything employed about the launch of the Leviathan, the vessel is once more on the move, inch by inch it is true, but still really and truly on the move, and on her way down to the muddy river. . . . . On Tuesday morning the pumping and pushing went on cheerily as of yore, and the vessel went on too; move she must, and move she did, despite all sinister rumours, and despite the nipping cold. Nearly a dozen rams, fed with warm water, butted against each cradle, and fires were kept burning as if to comfort them in their arduous labour, which, we are glad to say, ended for the day only when the ship had neared the water some 8 feet aft, and 3 feet forward. The average pressure required to start the vessel on Tuesday is stated to have been 1,300 tons, varying from 1,000 to 1,700 tons.

"On Wednesday the launching efforts were again resumed, and by the end of the day an additional 10 feet aft, and 9 feet 6 inches forward were made. On Thursday operations were again resumed, and the day's work told upon the vessel to the extent of eleven feet both forward and aft. This morning everything is at work again, and another 'last' attempt will be made to induce the Leviathan to float, and we hope the day's operations will be satisfactory. We trust it may never again fall to our lot to have to chronicle such a long catalogue of mishaps in any important engineering work, as we have had to do in the attempt to launch the great ship. There is, indeed, little chance of this work being required of us, at least as regards the floating of future monster ships; for there can be no doubt that hereafter vessels of this kind will be built in docks from which they may be at once floated."

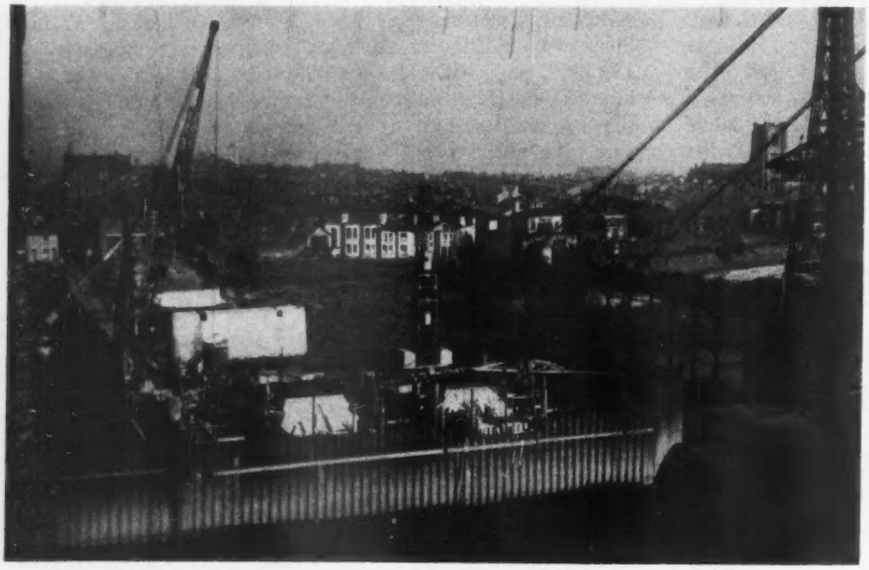
Bridge Construction



Queen Aliyah Bridge, Baghdad (shown right) and A' Immah Bridge, 5 miles upstream, are two more bridges completed across the River Tigris at Baghdad. Their lengths are 1487ft and 1037ft, and roadway widths 40ft and 30ft respectively. Queen Aliyah Bridge has a reinforced concrete deck in composite action with both the main and cross girders. With their approaches they took three and three-quarter years to complete

Taq Taq Bridge : this prestressed concrete bowstring arch bridge in the wilds of Kurdistan, has seven 150ft spans and a 20ft roadway. The Magnel Blaton system of prestressing was used and the bridge supports comprise twin reinforced concrete cylinders standing on caissons sunk under compressed air. The site is 60 miles from railhead and the road was often impassable. The bridge took two and three-quarter years to complete. Consultants (for all three bridges) : Coode and Partners. Contractors : Siemens Bauunion, M.A.N., and Waagner-Biro (Queen Aliyah and A' Immah bridges), and Beton-und-Monierbau (Taq Taq bridge)

Construction of only one really large bridge has been started in Great Britain since the war, the Runcorn-Widnes Bridge. A suspension bridge was originally proposed, but an investigation showed that it would be subjected to aerodynamic buffeting because of the railway bridge hard by, and a steel arch thus proved more economical. Here we show two recent views of substructure work on the bridge, which will be 1630ft long, with a central arch span of 1082ft and two continuous side spans. The rise of the arch is to be 253ft from bearings to top boom at the crown, and the distance between centres of trusses 54ft. The main members of the arch will be of high tensile steel and the secondary members of normal mild steel (total weight of steel about 5500 tons).



The bridge will carry a 33ft roadway and two 6ft footpaths. Under most severe live loading and wind, the maximum thrust from the arch at each bearing will be about 3500 tons at an angle of approximately 45 deg. to the horizontal.

During the last eighteen months, the foundations to take these loads have been under construction. The main skewback piers are founded on soft red sandstone, and are mainly of mass concrete construction. The one at Runcorn is built on the shore adjacent to the Manchester Ship Canal bank, and contains 4000 tons of concrete. On the Widnes side, the main skewback pier and the pier supporting the end of the short side span are on the foreshore of the River Mersey, where there is a tidal rise of 20ft at spring tides, and were built inside steel-sheet-pile cofferdams ; the skewback pier cofferdam is 140ft by 70ft, and the pier contains 7500 tons of concrete. Consultants, Mott, Hay and Anderson. Contractor (foundations), L. Fairclough, Ltd.

Civil Engineering in 1957

No. II—(*Concluded from page* 18, *January* 3)

SOLID achievements in actual construction in the application of newly developed theory or research, or in the introduction of improved plant or materials, are customarily recorded in this annual review, and form the bulk of its content year by year. Nineteen fifty-seven, however, affords an opportunity to turn aside for a moment from these matters (which indeed are given attention in the accompanying illustrations and in the art plates), for during the year a number of controversial projects of one kind or another were topical. Perhaps, all three mentioned here may never be built; nevertheless they are not without interest nor instruction. They have one thing in common: that the critical factor by which their value is judged is not technical feasibility but economic service, modified perhaps by other amenities which are not ascertainable precisely in economic terms. The economic yardstick for the Channel tunnel for instance is obviously whether its cost would not be better spent on conventional road construction since the necessity for good road communications has become so dominant.

Readers may compare the situation with that recorded in our note "100 Years Ago," published in the last issue of December, which dealt with a proposal of Sir Joseph Paxton for glass-covered thoroughfares. "We say nothing against the taste displayed by the glass architect in his designs, or that it would be impossible, physically, to work out his views; but considering the limited nature of our means for carrying out in London what is absolutely necessary, in order to render it tolerably healthy to live in, namely, its proper drainage, Sir Joseph's plan may be fairly said to be perfectly impracticable." A glance at Plate 9 will show that after a century main drainage problems are still with us, to the extent that large sums are being spent on purification works for both of the L.C.C.'s outfalls. What, then, is to be the interval of years, before London's road problem is solved, and the metropolis becomes "tolerably healthy" on that account, too?

Discussions about a European free trade area were held in 1957, and consequently interest in the Channel tunnel was revived. Present-day estimates of the cost of the tunnel favour a sum of £100 million. The tunnel would be driven in the chalk, it is generally assumed, relying on cementation or chemical treatment rather than compressed air (pressures would be too high) for protecting the face. This point is of special interest; the only major sub-aqueous tunnel project we have seen in this country for a good many years is the Dartford-Purfleet tunnel under the Thames, which was described in this journal on April 5, last, when work on the main underground drive was due to start. Grouting with bentonite and Portland cement grouts, as described in our article, has been relied upon to consolidate gravel overlying the chalk, thus illustrating a very promising line of improvement which may show itself in future tunnelling, namely improved methods of ground treatment.

Auckland Harbour bridge, New Zealand, showing constructional progress at the end of July, with steelwork erection just started. The bridge will be 3520ft long, with a navigation span of 800ft close to the far shore. The six bridge piers are founded on caissons, those for piers 1 and 2, which carry the navigation span having still to be sunk; it is expected that air pressures up to 50 lb per square inch will be needed for their construction. Sinking was still in progress on pier 3 at the end of the year, and the remaining three piers were further advanced or completed. Completion of the bridge is expected in mid-1959. Consultants, Freeman, Fox and Partners. Contractors, Dorman Long and Co., Ltd., and Cleveland Bridge and Engineering Company, Ltd.

An account of the history of the Channel tunnel projects was given in our issue of May 10, last, when several of the technical difficulties, together with possible remedies, were pointed out. The deep tunnel is not the only possible solution and suggestions have been made for a kind of "trench" tunnel, and for a bridge. In fact, we published as long ago as September, 1889, a detailed description of a proposal for a bridge between Cap Gris Nez and Folkestone, with which Sir John Fowler and Sir Benjamin Baker were associated. The bridge would have consisted of alternate spans of 500m and 300m (steel trusses, with a suspended truss of 125m in the centre of the longer span between 675m cantilevered trusses), the piers comprising large caissons, floated out and sunk in position. A cost of £34,500,000 was given "with reasonable certainty."

In mentioning the proposals for a road crossing of the Firth of Forth, we are far removed from that degree of improbability associated with the Channel tunnel. In fact, preparations for the construction of a suspension bridge with a main span of 3300ft are well advanced, and the contracts for the piers and anchorages were out to tender at the end of 1957, and work is expected to start in the middle of this year.

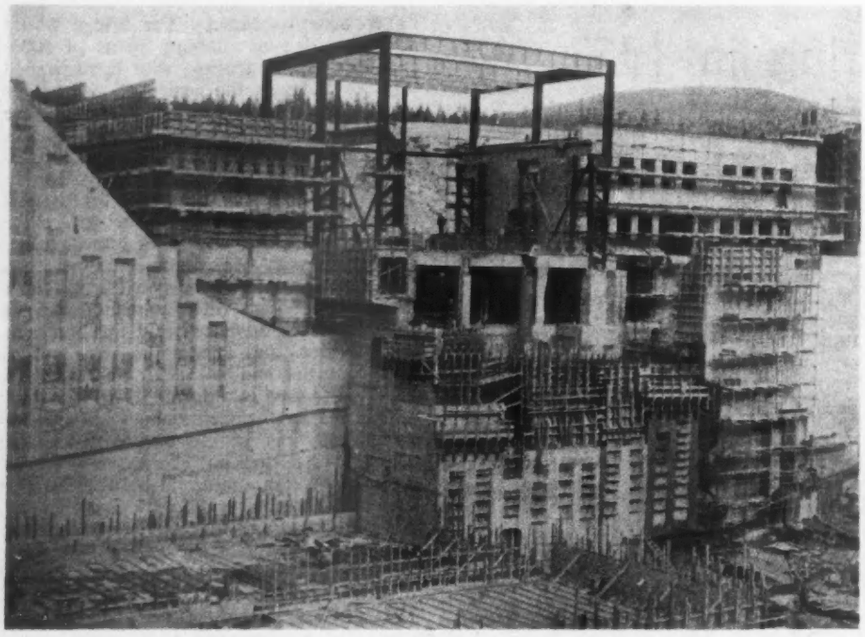
Our reason for mentioning the crossing here is to refer to a proposal which was rejected—that for an alternative form of crossing as an underwater tube, carried above the river bed on piles of large diameter. A report on the two alternatives, and selection of the bridge, actually occurred in 1956, but early last year we published* an account of both schemes. Since the "tube" scheme was of exceptional interest, it is worth recalling here amongst these other unusal projects.

Its novelty lay in the suggestion that a complete section of "tube," as large as 40,000 tons in weight and 700ft long, would have been prefabricated and floated into position. An ingenious method of joining two tubes, utilising the hydrostatic force of 3000 tons acting on one end of the floating tube to bring it up to the fixed one, was proposed. Steel tubular piles, 3ft in diameter, would have been driven through guides cast in the "tube" by plant on rails along the top of the tube, and later concreted.

The idea of a barrage across the Thames estuary, to impound the river at constant level, is just about as venerable as the Channel tunnel project. But it has been debated with more heat—either for or against—than the Channel tunnel. Shortly before the war a public inquiry into the barrage proposal was to have been held, until the Committee of Imperial Defence decided otherwise. The exponents of the barrage formed a body known as the Thames Barrage Association, which, we understand, has only recently been dissolved, due to the advancing years of many of its principal members. Thus it seems that the advantages which such a barrage would bestow are probably less well known to the present generation of civil engineers than would be expected. Further, the situation has been changed and is now more favourable for exponents of the barrage for two reasons: first, that the pre-war fear of aerial attack putting the port of London out of action by bombing the barrage is made obsolete by modern weapons; and second, that a barrier to stop storm surges travelling up the estuary is now considered necessary.

There is also one other factor which made this issue topical in 1957. Two of the D.S.I.R. establishments, the Hydraulics Research and Water Pollution Research laboratories, have been carrying out intricate and praiseworthy researches into the behaviour of the estuary over the past few years, and some results of this work became available during the year. The former laboratory's work prompted the Port of London Authority to change its dredging policy in favour of dumping dredged material ashore, since it was pointed out that currents of more saline, and hence heavier, water moved upstream along the river bed, bringing back the dredged material

* THE ENGINEER, February 15, 1957.



Another project in New Zealand, the Atiamura hydro-electric development on the Waikato River, North Island. 63MW will be generated. Here we show progress last August, at the right abutment, where workshops, the unloading bay, auxiliary sets, and offices are situated. In the foreground, note the cooling pipes for concreting bays 16 and 17 of the dam. Consultants, Sir Alexander Gibb and Partners. Construction by direct labour

in suspension. This research gives a fund of new knowledge about the estuary, and the effects of any specific proposal can be predicted.

Evidently changes can be expected in the estuary. It is too polluted, at present, to be tolerable by modern standards of cleanliness. Sewage purification works are under construction at the outfalls at Beckton and Crossness, and dredged material is to be taken ashore. It has also been suggested that cutting through the bend at Broadness would improve the river. And a surge-protecting barrier is being considered, though as far as we are aware the consultant's report on this barrier has not yet been published. Amongst all these changes, the old Thames barrage proposal seems likely to be forgotten. It may not, indeed, prove practical or economical, but it is a project of such potential merit that it deserves to be investigated in the fullest detail, making use of the new knowledge of the estuary and assessing it in comparison with the surge barrier,† against which, at first sight, it seems an immensely superior project.

Conservation of Natural Resources

During the session 1956-57, the Institution of Civil Engineers arranged a series of six lectures on the conservation of natural resources, which attracted wide interest. The series was published during the year, with an introductory lecture and foreword by Sir Harold Hartley, who pointed out that "these lectures are of special value as they describe and emphasise the major problems of conservation created by our modern way of living and our increasing population. They demand immediate attention . . . in most instances the primary responsibility for action must be with government, but the ultimate solution must lie with the engineer in his correct appraisal of each problem and his success in finding an effective solution. Looking broadly at the issues which these lectures raise, one is forced to wonder what course our way of living is likely to take over the next hundred years . . . these lectures touch upon some very profound problems of human density."

† See the leading article in THE ENGINEER, July 26, 1957.

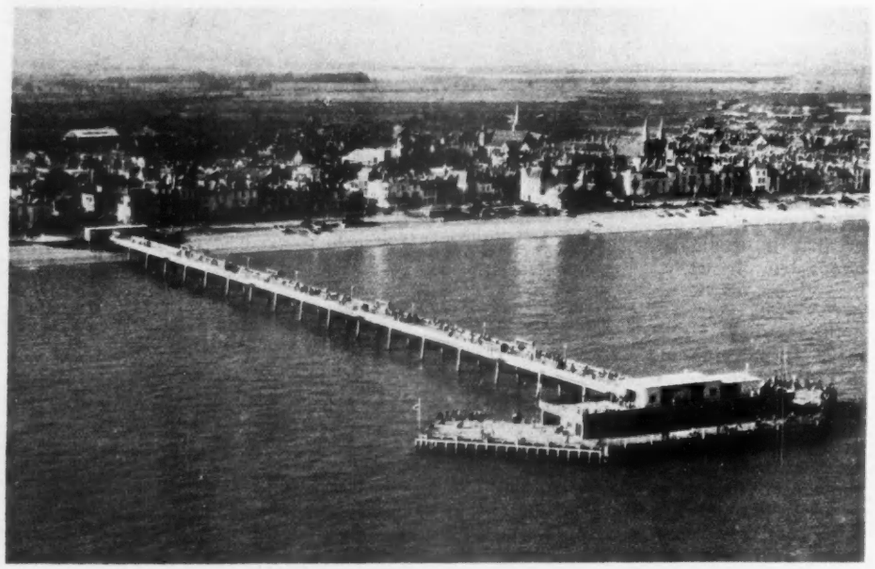
Lectures of direct bearing on the work of the civil engineer included Mr. G. M. Binnie's dissertation on water, and an account of the use of waste materials by Mr. R. M. Finch, the latter being noteworthy for the practical proposals set out for the use of waste materials and the reclamation of derelict land. Professor Dudley Stamp, who lectured on "land," made some challenging statements; he suggested that modern engineering resources might be able to add 250,000 acres to our scarce resources of best-quality agricultural land.

Some modest progress can be recorded during 1957. It was pointed out by Mr. H. J. B. Harding at the "Civils'" highway conference that such concepts needed to be applied to motorway construction; topsoil should be saved, and local materials and conditions studied. A paper on the use of locally available low grade materials for road construction was read by Mr. F. W. Ingle before a branch meeting of the Institution of Highway Engineers last April. And in actual construction, we find that burnt colliery shale, a local waste product, is being extensively used on the Preston by-pass, and the Metropolitan Water Board is conserving topsoil from the site of a new reservoir.

In other directions also, waste materials were being utilised. In Plate 5 of our issue of last week, we showed a plant installed during 1957 at Battersea for making lightweight aggregate for concrete from power station ash. A plant for the same purpose, but utilising carbonaceous shale from a pit heap, was put to work at Denby in Derbyshire during the year. Disposal of such materials is not by any means universally directed to useful ends, however, and the year also saw the presentation of a paper on the behaviour of power station ash when discharged into the sea.‡ We also drew attention during the year to the attractiveness of extending the use of slag and power station ash in cement manufacture or as additives, replacing some cement, in the concrete mix. (THE ENGINEER, October 25, last.)

The discharge of crude or partly purified sewage into rivers or the sea is a malpractice particularly criticised by exponents of "conservation," since the harm done is twofold, creating pollution and wasting "humus." Their case was reinforced last summer by the suggestion, and subsequent discussion, in the Press that there was a connection between the incidence of poliomyelitis and bathing in polluted sea-water. This matter was discussed in our issue of August 23.

‡ "An Investigation Into a Proposal to Dispose of Power Station Ash by Discharging it Into the Sea at Low Water," by F. L. Harwood and K. C. Wilson. *Proceedings I.C.E.*, Sept.



The new pier at Deal was opened on November 19. The pierhead, covering 15,000 square feet, comprises the promenade deck (in steel beams encased in a r.c. slab), the main landing deck and two small boat decks (of timber decking on concrete-encased steel beams), and is supported on steel piles encased in concrete. The fendering system consists of high-tensile-steel broad flange beams used as piles and driven vertically to a penetration of about 20ft, braced at three levels with high-tensile-steel broad-flanged-beam walings. The approach is 900ft long by 22ft 6in wide and consists of a r.c. deck slab composite with encased steel castellated beams, on steel piled bents at 50ft centres which comprise box piles, raked at 1 in 10, penetrating 15ft into chalk and braced by a welded steel joist transom cased in concrete. Casings are 24in diameter precast r.c. pipes and the casings and the steel piles are filled with concrete. Consultants, Sir William Halcrow and Partners; contractor, Concrete Piling, Ltd.

Royal Navy—1957

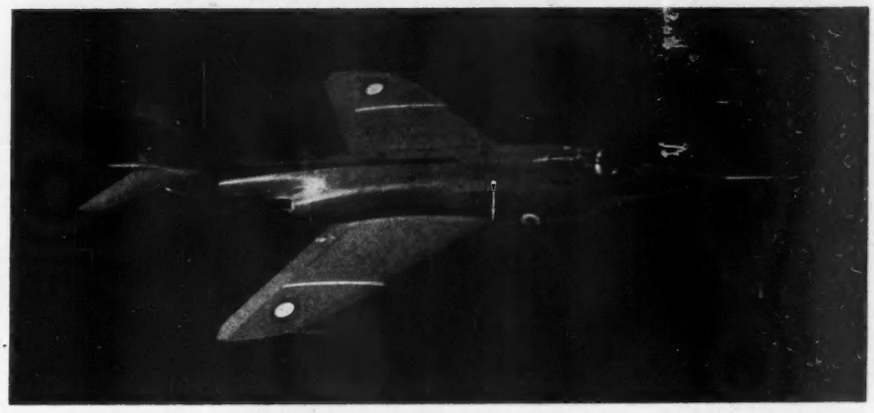
No. II—(*Concluded from page* 16, *January* 3)

The Fleet Air Arm

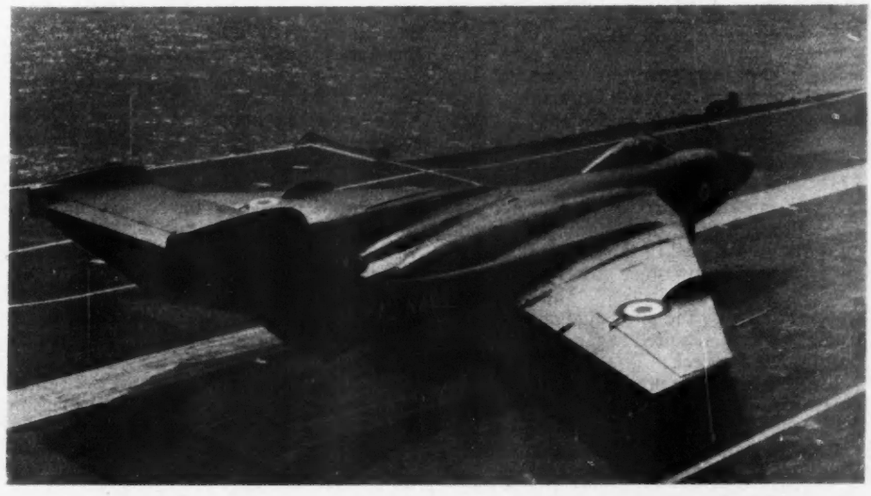
WHATEVER their function in global war, carrier-borne aircraft—" Sea Hawks," "Sea Venoms" and "Wyverns"—provided the main air support for the Port Said operation. But in a future localised campaign of this kind we may be faced with an enemy well provided with modern aircraft and weapons. Replacements for these straight-wing aircraft are urgently required and it was thus not a moment too soon that a flight of " Scimitars " was formed last year at Ford. These are the new naval twin-engined day fighters—the " N113 "—which are to replace the " Sea Hawks." They are powered by two Rolls-Royce " Avon " engines, armed with four 30mm Aden cannon, and are capable of carrying the atomic bomb. They are fitted with the " flap blowing " system for increasing the lift at high incidence thus reducing landing and taking-off speeds. The advantage of this device for carrier-borne aircraft needs no emphasis, and its operation in service will be attentively watched. It is anticipated that a " Scimitar " squadron will be formed for embarkation in carriers during 1958. Another new naval aircraft which has carried out successful deck landing trials is the night and all-weather fighter " D.H.110," now to be called the " Sea Vixen," which is to replace the " Sea Venom." Also powered with two Rolls-Royce " Avons," she is to be armed with air-to-air guided weapons, and it is hoped that the first flight should be formed up in the coming year. The aerial defence of the Fleet will largely depend on the " Sea Vixen," both as a day interceptor and as an all-weather fighter, but she will not have the climb performance to attack a supersonic bomber flying at 70,000ft. It is no doubt too much to expect in these days of economy that an aircraft with a mixed power plant can be allocated for naval war.

There are now six squadrons of " Sea Hawks," four squadrons of " Sea Venoms," and two squadrons of " Wyverns " available for carriers. The " Wyverns "—the Navy's only strike aircraft—are in due course to be replaced by the " NA39," a twin-engined machine capable of supersonic speeds, now under development. The " NA39 "—which is still a long way off—is also to carry the atomic bomb and to have a much greater range than the " Wyvern." The Fairey " Gannet "—the Navy's three-seater anti-submarine aircraft—has given excellent results on service. The power plant is an Armstrong Siddeley " Double Mamba," which consists basically of two " Mamba " turbo-prop engines placed side by side, each driving one of two co-axial contra-rotating airscrews. A production order has been given for a new mark of the Fairey " Gannet "—the A.E.W. Mark III—which will replace the Douglas " Skyraider " for airborne early warning duties. It is worth noting that an aircraft's search radar at 25,000ft extends a carrier's radar range to a distance of 200 miles. It is, indeed, fortunate that the Royal Navy has a first-rate, fixed-wing anti-submarine aircraft already in service. In view of the increasing importance attached to the helicopter for anti-submarine work, the Fairey " Gannet " may well be the last of her type to be built and have to bear the brunt of anti-submarine work until the helicopter takes over in a few years' time. Westland " Whirlwind " helicopters are being delivered to the Navy in considerable numbers, and a production order has now been given for the new Westland " Wessex " anti-submarine helicopter. Powered with a Napier " Gazelle " gas turbine, she is capable of carrying a guided missile for homing on to a submarine.

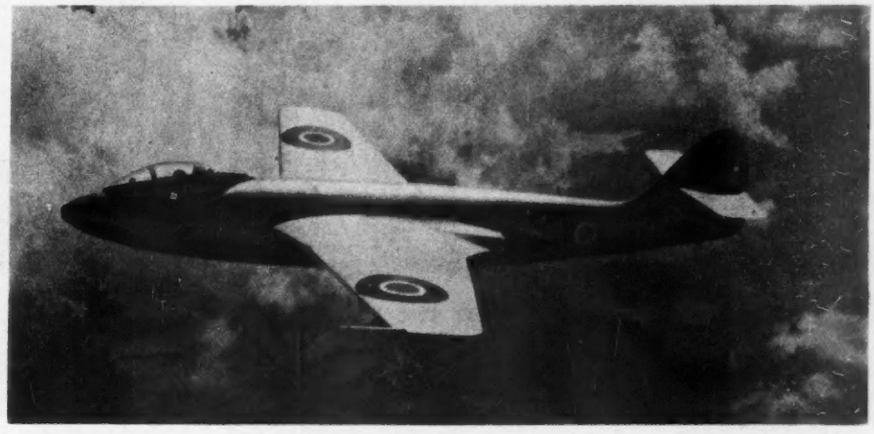
There has been no official information of the development of anti-submarine guided missiles in this country, but the type visualised for the Westland " Wessex " is possibly similar to the " Petrel "—a guided missile now in service with United States carrier-borne patrol squadrons. It is virtually a 24in torpedo, equipped with a turbo-jet engine, a lifting wing, tail unit and guidance and control mechanism. After launching, the " Petrel " dives down close to the surface until checked by a radio altimeter. The turbo-jet, wings and tail unit are then discarded and the missile acts like a homing torpedo to find its target below the surface. After nearly five years' service in the jungle



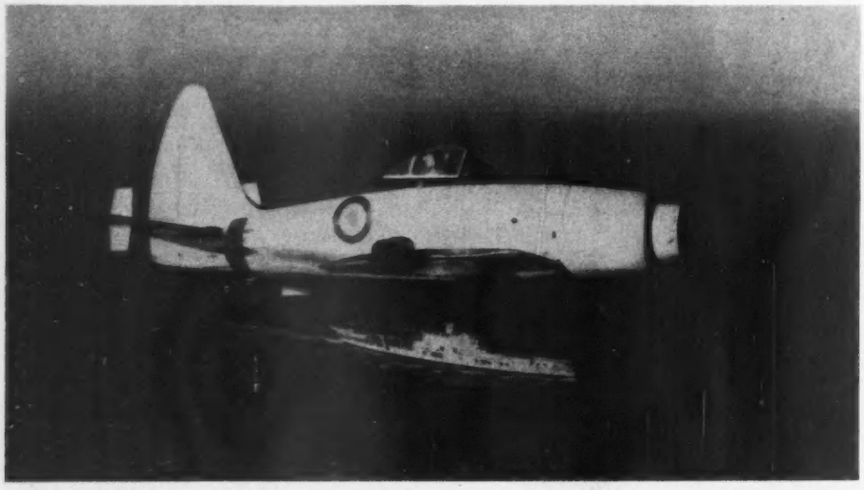
Vickers-Armstrongs Supermarine " N113 "—" Scimitar "—the new twin-engined transonic naval interceptor fighter



The de Havilland " 110," the " Sea Vixen," the Navy's future day and night all-weather subsonic jet fighter



The " Sea Hawk," the Navy's standard day fighter



The "Wyvern," the Navy's strike aircraft, to be replaced by the "NA39" now under development

area, No. 848 naval helicopter squadron—ten Sikorsky "55s"—was withdrawn from Malaya early last year. Apart from mine-sweeping and other naval uses, helicopters are now becoming increasingly important for amphibious operations. Plans have been prepared for converting a "Glory" class carrier for operating twenty of the new Westland "Wessex" helicopters to land a commando of 600 Royal Marines. The angled deck and the mirror landing sight—both British inventions—have not only greatly reduced the landing accident rate in carriers (the number of landing accidents due to pilot errors has fallen to one-fifth of the previous figure), but they have very considerably improved operating efficiency. The Americans—who, with the Dominions, have adopted these British inventions in their carriers—estimate that the saving resulting from fewer accidents is in the region of £7,000,000 annually. It is interesting to note in this connection that forty years ago last August the very first deck landing was made on a British carrier. In those days there was no arrester gear or other aids to bring the aircraft to a standstill. The machine stopped solely by the pilot's judgment of the landing speed required against the wind speed down the deck.

British carriers are now using operationally a new method of flight deck communications called the Flight Deck Magnetic Broadcast system designed by British Communications Corporations, Ltd. With the increasing power of jet aircraft, the high ambient noise level on the flight deck has created a serious problem in the passing of orders from Flying Control to the Flight Deck Party. The new system enables Flying Control to communicate direct with the Flight Deck Officer and key personnel of the Flight Deck Party, who each wear miniature transistorised pocket receivers connected to ear pieces in their noise-excluding helmets. Arrangements can be made for the Flight Deck Officer to give orders to his staff via this system. Transmissions are not radiated outside the immediate area of the Flight Deck and do not therefore prejudice security.

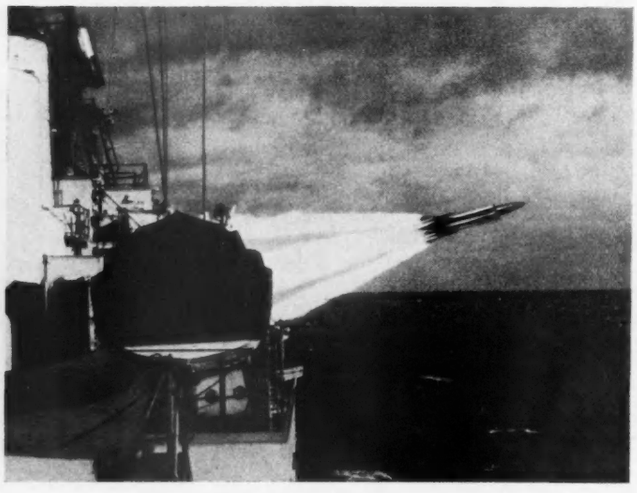
Research and Development

The need for economies in defence spending has considerably curtailed the Navy's research and development programme and, apart from basic research, most of the money available is being devoted to the development of guided missiles and nuclear propulsion. With atomic power plants in submarines, radar is no longer effective as an anti-submarine measure, and it is thus of the highest importance that we have now designed an asdic set with several times greater range than anything we possessed in the second world war. Equally satisfactory is the decision to set up a committee, under the chairmanship of the Civil Lord, to study the best way of making progress in the application of nuclear propulsion to commercial shipping and other surface ships. An atomic power plant will confer immense advantages on the submarine of the future. But neither Britain nor N.A.T.O. can defend the vital sea communications with submarines. The Fleet train—provided the number of ships is adequate—will do much to compensate for the oversea bases we are having to abandon for political or economic reasons. But N.A.T.O. must aim at having Task Forces which can steam indefinitely at 25 or 30 knots and be independent of fuel. The trials of the Navy's surface-to-air guided missile "Sea Slug"—which the Admiralty claims will engage modern hostile aircraft at any range at which they are capable of operating—have proved satisfactory, and the missile is to be fitted in the four new fleet escort vessels. It is fired from a triple ramp, loaded automatically from a magazine below decks.

Both the new fleet escort vessels and general purpose frigates are to be equipped with a combination of steam turbines and gas turbines. The gas turbine not only provides a "booster" when higher speeds are required but will enable the ships to get under way at a few minutes' notice when steam is not available.

In last year's review it was pointed out that the "one man chamber" for escaping from submarines had been abandoned as inherently unreliable. The new method of "free ascent" to the surface via a twill trunk after flooding the compartment has been adopted as standard for escapes. All existing submarines have therefore now been equipped with a built-in breathing system at the forward and after ends, consisting of bottles of 60 per cent nitrogen and 40 per cent oxygen, which the crew breathe while the compartment is being flooded up. Escape by this method, however, has little chance of success at depths much over 200ft, and investigations have been made into the United States method of escaping by means of a diving or "rescue" bell which is attached by a diver to the escape hatch of a submarine, thus avoiding the discomfort and risk of a "free ascent" to the surface. The Admiralty, however, have decided that the chances of escape by this method are extremely small, and that the new equipment required would impose weight penalties and other disadvantages which would reduce the submarine's chances of survival in war. The United States Navy, which has adopted the British "free ascent" method, has also

The Westland "Wessex," in production for the Navy for anti-submarine duties. Powered by a Napier "Gazelle" shaft turbine

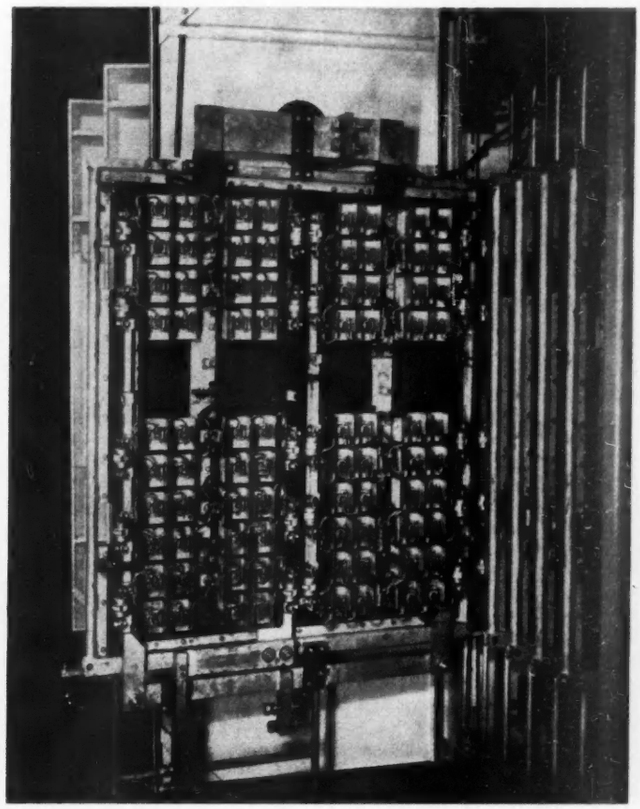


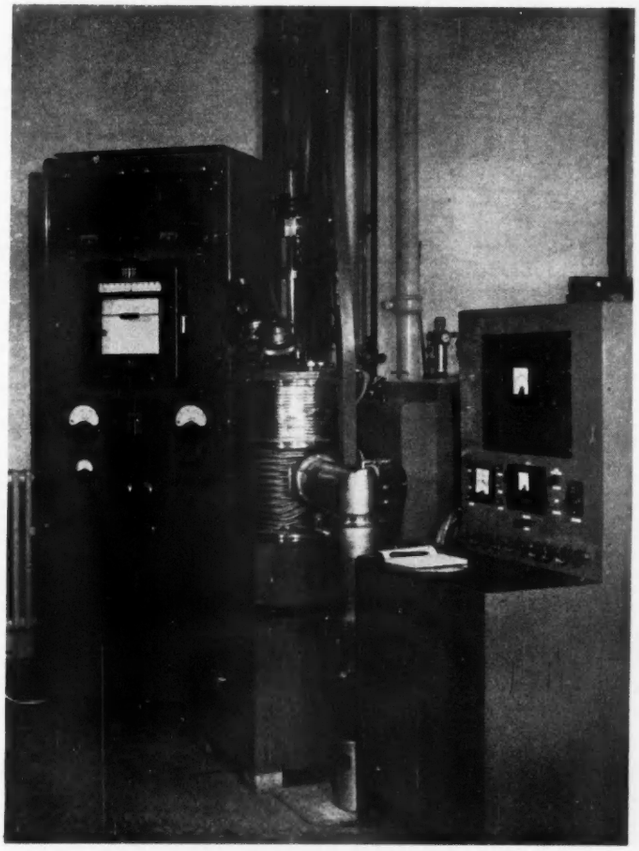
The Navy's anti-submarine guided missile "Sea Slug" being fired from H.M.S. "Girdle Ness"

Semi-Conductors

A number of factories for the production of semi-conductor rectifiers and transistors have been established in this country during 1957, as recorded in our pages. Photographs showing some of the manufacturing processes in germanium semi-conductor devices are reproduced here. A very high standard of purity is required in the raw material and purification is done by "zone refining"—a process in which a germanium ingot is taken through a silica tube surrounded by a series of r.f. induction coils. Because of preferential solubility the impurities tend to collect in the molten zone produced in the germanium by the r.f. coils. As the ingot progresses along the tube the impurities move with the molten zone and are concentrated in the rear end of the ingot, leaving the rest relatively pure. From this polycrystalline ingot a single crystal is produced by growing from a seed crystal immersed in a molten pool of the purified germanium. During this process the seed crystal is slowly rotated and is withdrawn as it grows. The crystal growing machine illustrated below has been developed and installed at the research laboratories of The General Electric Company, Ltd. On such automatic machines crystals can be grown consistently.

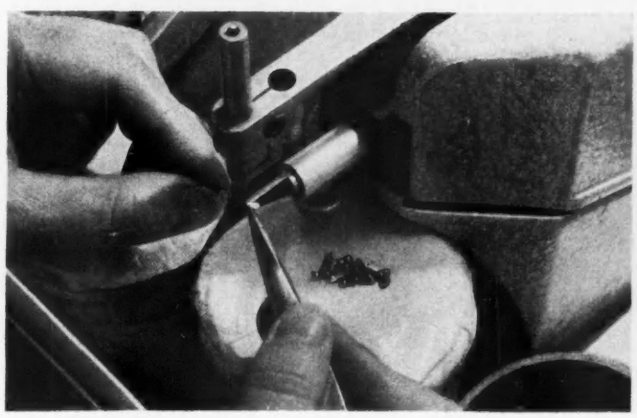
At this point differences appear in the manufacturing techniques, depending upon whether the end-product is to be a transistor or a power rectifier, but the principles are broadly the same. The next process is to cut the single crystal into thin wafers. In the case of the power rectifier, the cutting is usually done with a thin tungsten wire covered with a fluid carrying an abrasive powder. An earlier version of a cutting machine developed for this purpose and used by the British Thomson-Houston Company, Ltd., in the company's new air conditioned factory for producing semi-conductor rectifiers at Rugby, is shown

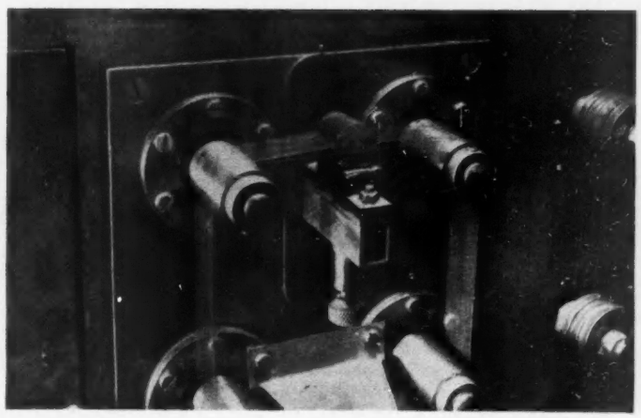




below. A typical wafer is 0·4in square and 0·030in thick. In the case of germanium transistors the wafers are considerably smaller; typical dimensions are of the order of 2mm square by 0·25mm thick before etching, to quote the practice adopted at the new Mullard factory on the Millbrook Trading Estate, Southampton. The next stage is to etch the germanium wafers and then to measure the final thickness which must be 0·15mm ± 5 microns. The germanium dice are then ready to receive the pellets of indium which must be fused to the parent to constitute the emitters and collectors. Accordingly, these indium pellets are alloyed, one to each face of the germanium wafer, the process being carried out in carbon jigs in a multi-stage furnace under a controlled gaseous atmosphere. The alloyed wafers now have the essential properties of transistors and are ready to be mounted on glass bases in preparation for the attachment of the nickel connecting wires. These transistor elements are then etched in a chemical solution to remove surface contamination before being subjected to preliminary tests and having their protective envelopes fitted. Next, the connecting wires are tinned on a rotary machine. They are soldered to the base, the emitter and the collector, respectively. Soldering, which is illustrated below, left, is carried out in a stream of hot gas and is a very delicate operation in which accuracy is achieved by making use of optical aids. The transistors are then hermetically sealed into capsules in a glove box under conditions of closely controlled humidity. Finally, the completed transistors are tested.

Power rectifiers are built up from rectifier elements made from wafers cut as shown in the illustration below. The equipment illustrated above is a typical product of the B.T.H. semi-conductor factory, Rugby; it is an assembly of three germanium rectifier cubicles having an output of 13,000A at 150V, and one of the six trays in a cubicle is shown withdrawn for inspection

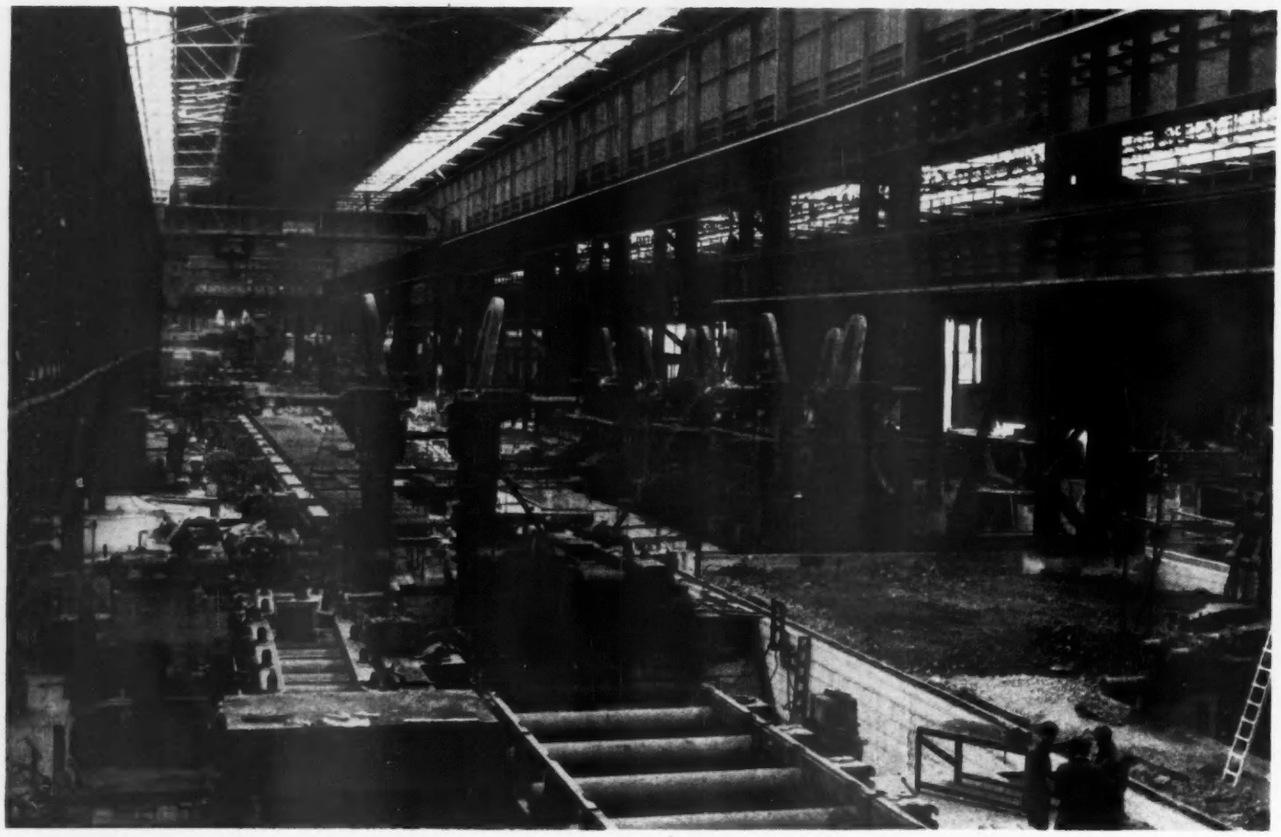




Lackenby Beam Mill

By the end of 1957 the universal beam mill at the Lackenby Works of Dorman Long and Co., Ltd., was almost ready to begin operations. The mill has been fittingly described as the climax of the company's development programme ; it has been designed for the production of a comprehensive range of universal beams varying from beams 36in deep with 16½in wide flanges to 6in deep with 6in flanges. More than £60,000,000 has been spent by Dorman Long and Co., Ltd., on the various stages of its development scheme in recent years, and of that sum, about £18,000,000 has been required for the beam mill. The beam rolling technique which will be followed was described in a recent paper to the Institution of Structural Engineers (see "The Engineer" of November 8, 1957). Fundamentally the process is similar to that developed on the Continent by Henry Grey, but applies modern mill engineering to the four-roll technique. The universal mill rolling unit consists of a four-roll or main stand, with a two-high supplementary stand in line with and as close to the main stand as possible. Horizontal and vertical rolls are adjusted between passes and reduction in the thickness of both web and flange takes place in the main stand. The supplementary stand has two rolls only and works the edges of the flanges, squaring up and controlling their length. In the main stand the setting of the vertical and horizontal rolls for each separate pass is arranged so that the elongation of the web and the flange is controlled with precision, ensuring that all parts of the section rolled elongate equally. The present intention is to roll forty-four different sizes of beam sections and twenty-seven column sections. The beams cover a range of fifteen serial sizes, many of which have three or four specified weights per foot. The columns cover a range of six serial sizes, one of which has seven different weights per foot and all of which have flange widths approximately equal to the depth of section. In addition, there is provision for rolling twenty sizes of angles, channels and piling.

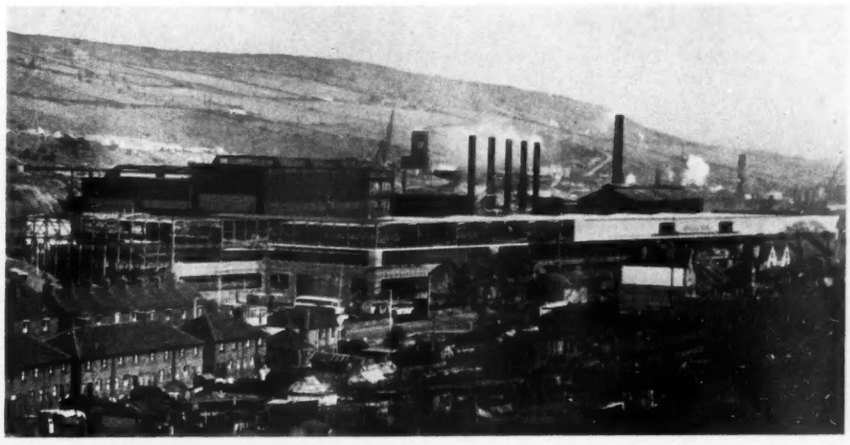
The mill building at Lackenby is 3000ft long and covers 28 acres. Ultimately, in addition to the universal beam mill it will accommodate a billet mill and a rod, bar and narrow strip mill. The upper illustration is a general picture of the mill during construction, with the 48in blooming mill and shear shown in the foreground. Below the beam roughing stands are shown under construction. Steel for the production of the universal beams will come from the open hearth plant at Lackenby, which was completed about four years ago

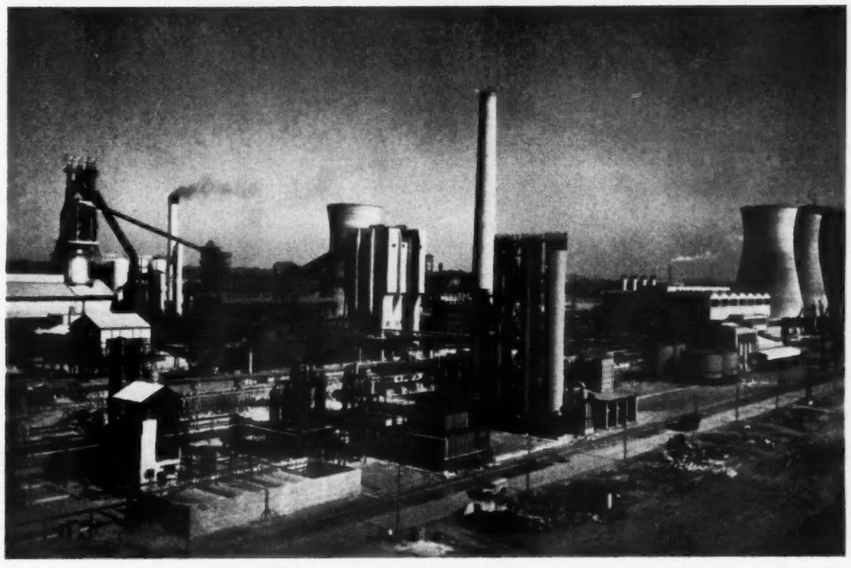


Iron and Steel

A bar and rod mill, designed to roll at over 3000ft a minute in the finishing train, is being built at the Stocksbridge works, Sheffield, of Samuel Fox and Co., Ltd., a subsidiary of The United Steel Companies, Ltd. The accompanying illustration shows the main buildings which were completed during the year. The rolling mill bay, which is 850ft long, will accommodate a three-stand, 18in roughing mill train and a four-stand, 11in intermediate train. Other items in the installation are a four-stand, 11in to 14in cross-country mill and a six-stand, 10in continuous finishing train.

A notable stage in the development project being undertaken by Colvilles, Ltd., was reached last summer when the Ravenscraig iron and steel plant was started up. The plant has been built on a site, occupying more than a square mile, which is near

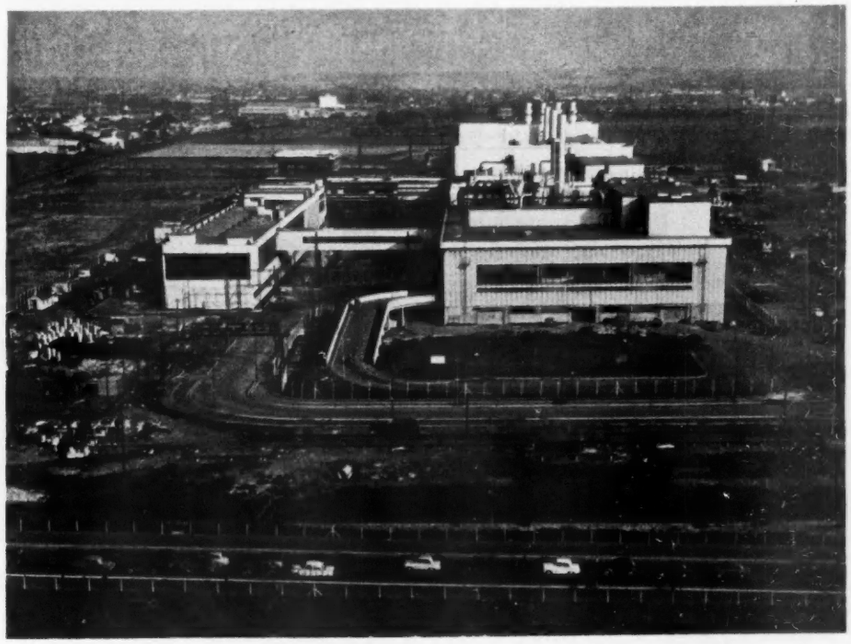




to the company's Dalzell works at Motherwell. The project was started in 1954, and that part of it which has now been completed includes a coke-oven plant, a blast-furnace and a steel melting shop. The second illustration presents a general view of the Ravenscraig plant taken from the melting shop. The seventy coke-ovens, in two batteries of thirty-five each, have been designed to carbonise 1600 tons of crushed coal a day. The blast-furnace has a hearth diameter of 25ft 9in, its rated output being 1000 tons of iron a day. The furnace is equipped with double charging skips, each of 220 cubic feet capacity, which deliver to a rotary distributor. The ancillary equipment includes a gas cleaning plant and a single-strand sintering machine capable of a maximum weekly output of 10,000 tons of finished sinter. The melting shop is equipped with 800-ton inactive mixers and 200-ton fixed open-hearth furnaces, the estimated production, initially, being 400,000 tons of ingots a year. The furnaces are water-cooled and are fired with a combination of coke-oven gas and liquid fuel.

Although not coming strictly within the scope of iron and steel development, the Thames Foundry, built by The Ford Motor Company, Ltd., at Dagenham, is one of the significant achievements of the past year. This illustration shows the complete foundry. The main building, on the right of our picture, is 1200ft long and 180ft wide ; it accommodates the principal foundry operations of melting, moulding, core-making and fettling. This building is a two-floor structure, the lower floor accommodating the maintenance equipment, offices, stores, locker rooms, showers and the canteen. The ancillary building, shown on the left of the illustration, measures 700ft by 60ft by 70ft, and contains the sand handling and drying, casting cooling, grinding and cleaning sections.

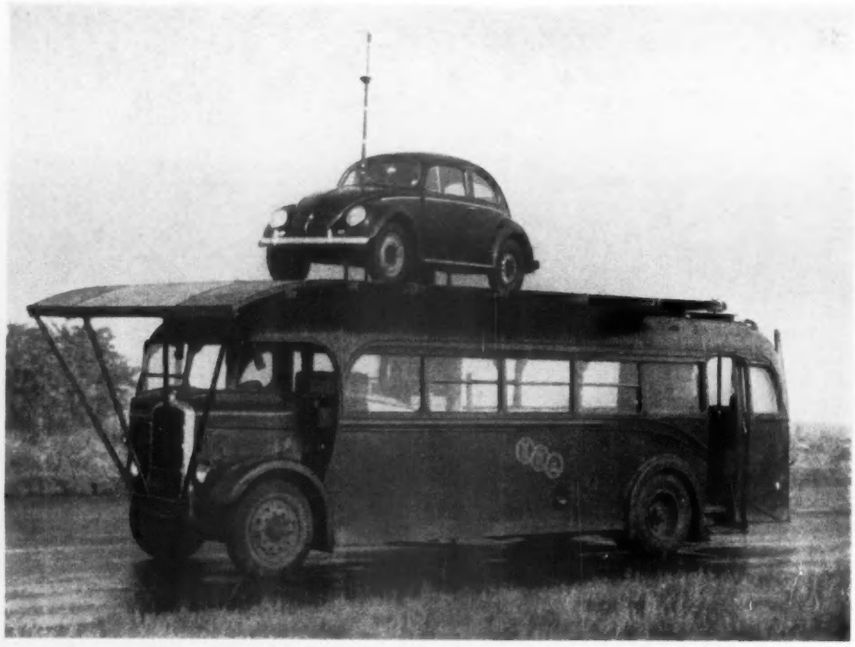
The new foundry is fully mechanised, the power capacity being approximately 15,000kVA ; there are five substations on the roof of the main building. Pig iron and coke are brought to the foundry in rail wagons, and there is a telpher system for lifting the containers from the wagons and conveying the coke to storage hoppers adjacent to the cupola melting units. Skip hoist machines load weighed charges of pig iron, scrap, coke and limestone into four 108in diameter hot-blast, water-cooled cupolas, each of which has an 8-ton receiver for pouring the hot metal into ladles. The foundry has been planned for an output of about 400 tons of castings a day

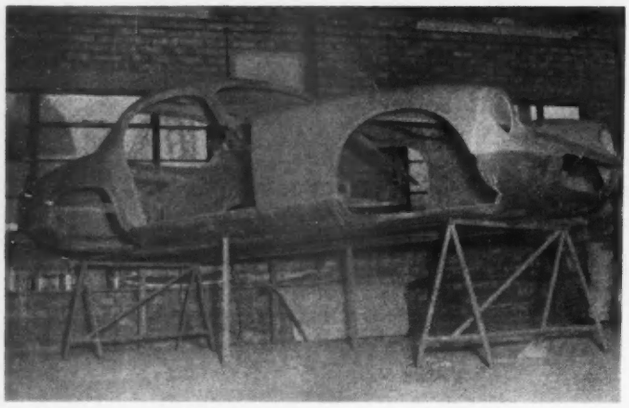


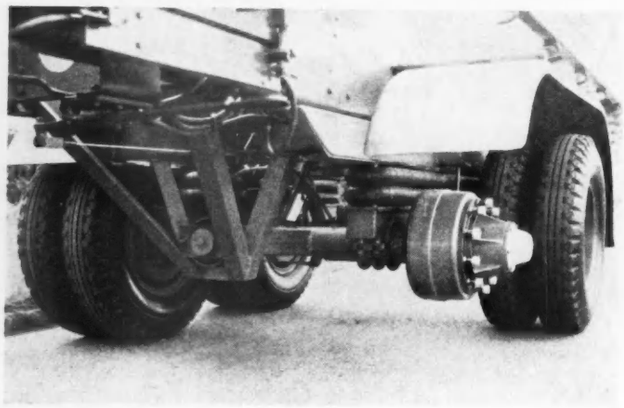
Vehicle Engineering

A rig intended to measure the air forces on a car has been built by English Racing Automobiles, Ltd. The car is carried above a flat platform which, as can be seen on the right, has been shaped to provide an approximation to a uniform velocity field over the platform. A turntable flush with the platform carries the car, there being four slots in its upper surface to admit the tyres to the appropriate depth. The vehicle is supported on four struts, one at each end and one at each side; there is a ball joint at the foot of each strut and a pin joint at the top. The side load on each strut is thus known in direction and can be measured by strain gauging; running from a stabilised power pack, the strain gauges yielded highly repeatable results, and were able to assess forces as low as 3 lb wt. Acceleration forces were obtained by observing Tapley meters. The car had a mast which carried air speed and direction pick-offs. It proved possible to obtain drag, side force and yawing moment derivatives by this method quickly and relatively inexpensively.

This country was the first to put into production air suspensions for vehicles, Dowty "Oleomatic" springing being used on pre-war racing and post-war road Velocettes, Scott and "Panther" motor-cycles. There is now again an air-sprung British vehicle in production, the Dyson "Haulmaster" trailer with

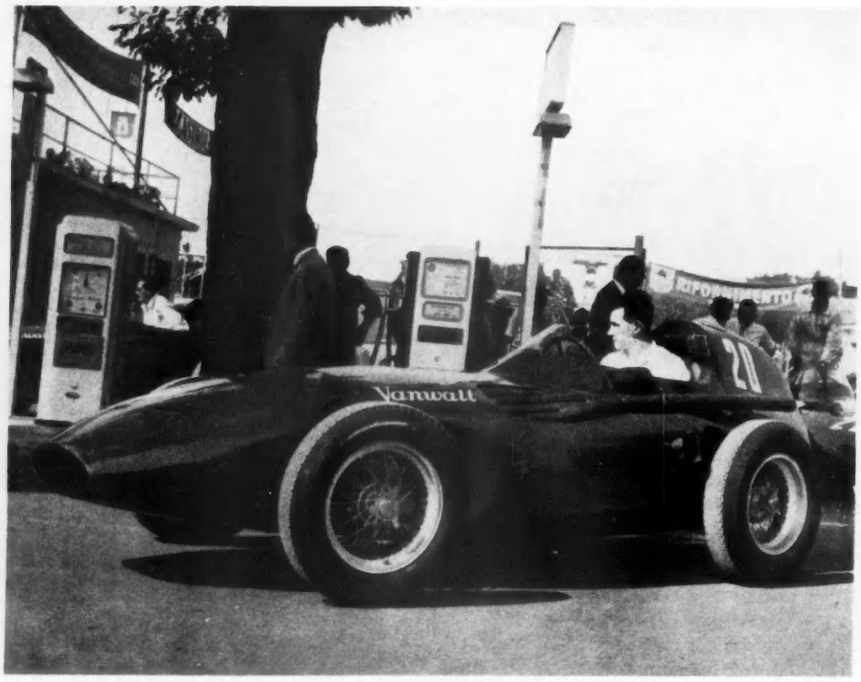






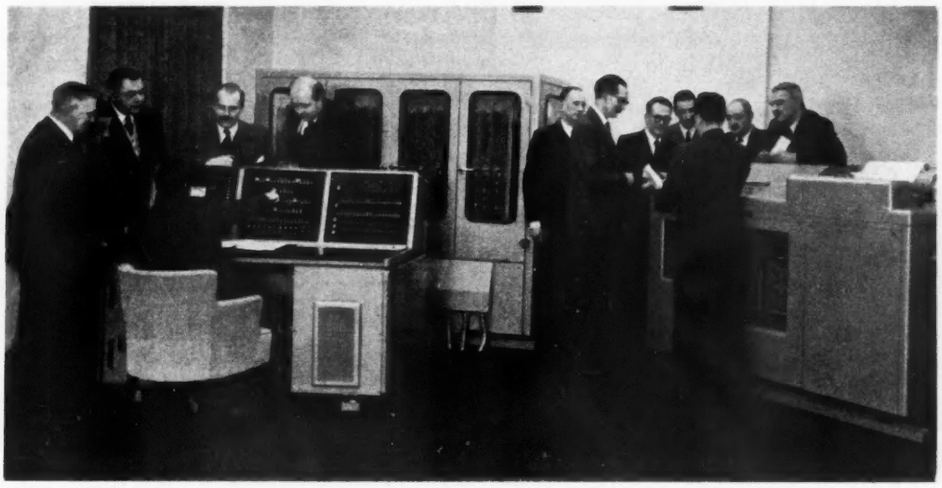
G.T.R. suspension produced by the Andre Rubber Company. T-shaped axle beams are joined by beams acting as compression chambers, on which the air bags rest, and to the chassis by rubber bushes. In the illustration above right, the levelling gear has been over-ridden to bring the beams on to the rebound stops and one pair of wheels removed. The Lotus "Elite" coupé has a stressed body of glass-reinforced polyester and epoxy resin. Above can be seen the outer shell, devoid of the metal-reinforced bulkheads which carry the engine and final drive; the steel tube which carries the loads into the roof panel can be seen. Another distinctive feature is an independent rear suspension resembling the MacPherson system, with the drive shafts acting as track control links; in the absence of steering linkage, both camber and toe-in change with load, and this is claimed to offset centre of gravity movement.

Great Britain enjoyed unprecedented success in Grand Prix racing in 1957, the Vanwall winning three races. The engine is a four cylinder 96mm by 86mm, with exposed hairpin valve springs; the interior of the engine is derived in part from the racing Norton single. Amal carburetters serve solely to throttle the air flow, the fuel being directly injected by a Bosch pump; the pump is regulated mechanically from the throttles. A five-speed, baulked-synchromesh gearbox is included in the final drive, and rear suspension is de Dion with negative camber



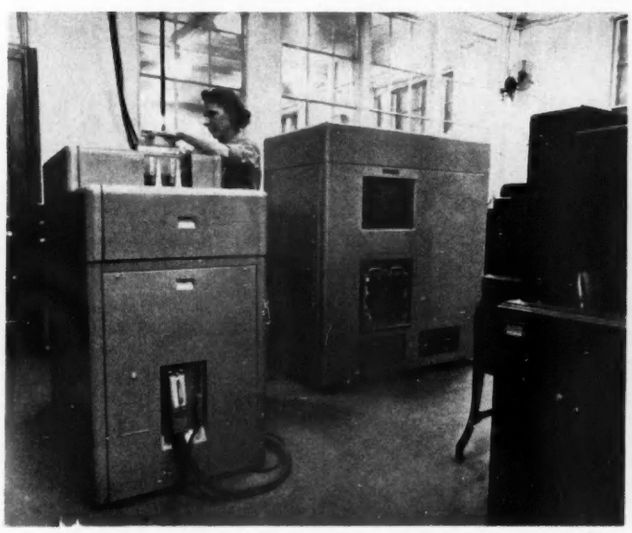
Commercial Computers

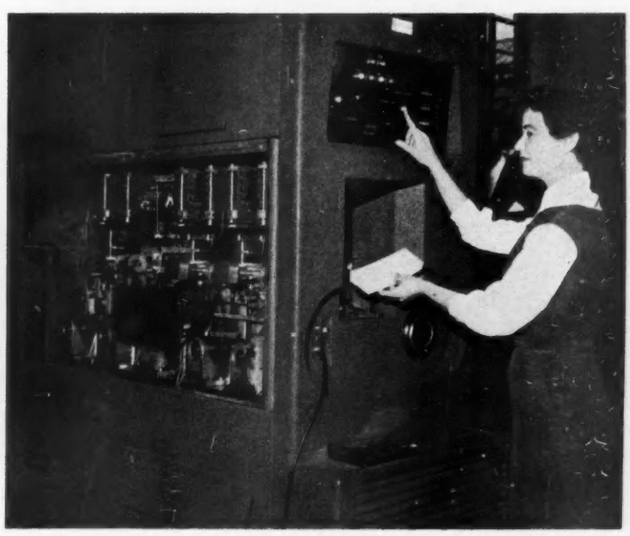
Electronic digital computers suitable for commercial application are now being produced in Great Britain in increasing numbers. To help with the dissemination of knowledge about computers and what they can do, several manufacturers have set up computer centres, where potential users can study existing equipments and assess their capabilities, and where operators can be trained. One such centre has been installed at 36, Hertford Street, London, W.1, by the British Tabulating Machine Company, Ltd., and was opened recently by Sir David Eccles. A general view of the main demonstration room of this centre, showing the company's Hec general purpose electronic computer is shown in the illustration below. One application of this computer in production control is in the study of workshop loading, and a Hec installation is being used to maintain improved work flow through the company's Letchworth factory, where these computers and other Hollerith machines are made



An interesting application of electronic computers in data processing is illustrated above. This picture shows the installation of a National-Elliott "405" data processing system, consisting of a computer, with magnetic film storage and punched-paper tape input and output equipments, installed in the City Treasurer's Department, Norwich. It is to be used initially for the preparation of rate demand notes and the maintenance of ratepayers' personal accounts. The equipment is made by Elliott Brothers (London), Ltd., and is marketed in the United Kingdom by the National Cash Register Company, Ltd.

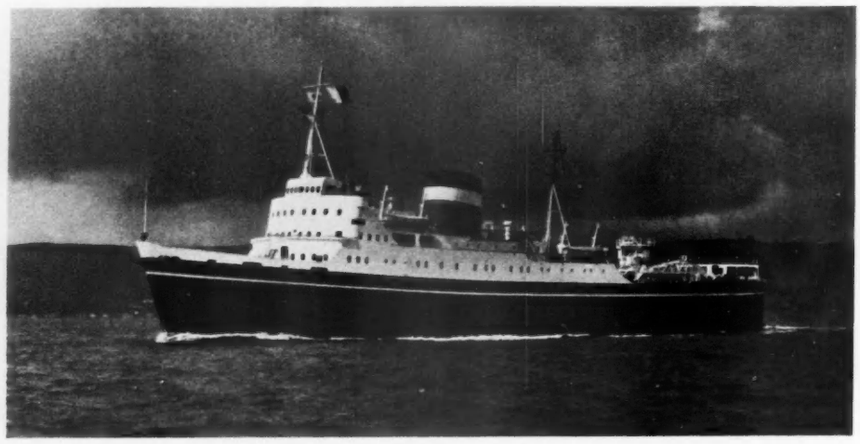
Computers were brought into use last year on two regions of British Railways and they are illustrated below. On the right is part of the Powers-Samas Programme-Controlled Computer which was formally inaugurated at the Western Region's accounts office at Swindon, where it is being used mainly for payroll compilation to handle the wages of 10,000 railway workers in the locomotive and carriage and wagon works. The computer can feed, process and punch, up to 7200 cards an hour, working directly with decimal numbers and sterling without conversion to any other system of notation. For any particular application the appropriate programme is set up on special programme units which are put into the machine as required—and these units can be used repeatedly until the routine requires amendment. The machine has a "memory" derived from a main store of 2560 sterling or decimal digits, as well as six immediate access stores. The other installation, illustrated below, left, consists of a Hollerith "550" electronic calculator, used for mechanised accountancy in the Derby offices of the Midland Region of British Railways

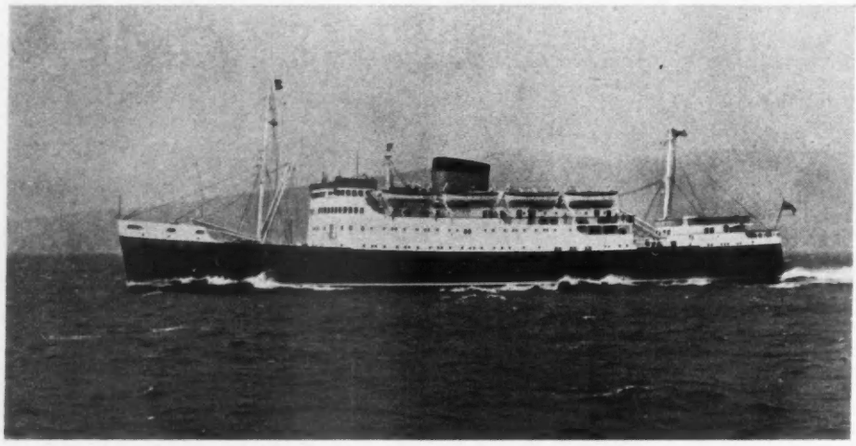




Coastwise Shipping

The passenger and vehicle carrying "Bardic Ferry" was built by William Denny and Brothers, Ltd., mainly for the Preston-Northern Ireland service of the Atlantic Steam Navigation Company, Ltd., and the following are the main particulars :—length overall 338ft ; breadth moulded 52ft ; depth to vehicle deck 16ft ; load draught 12ft 8½in ; deadweight 1320 tons ; and speed 14 knots. Accommodation for 55 passengers is provided with 16,000 square feet for vehicles and containers; there are twin rudders aft and one bow rudder and also Denny-Brown stabilisers. Three 150kW diesel driven generators supply power for the deck machinery and auxiliaries and the ship is powered by two ten-cylinder Sulzer two-stroke trunk-piston diesel engines.



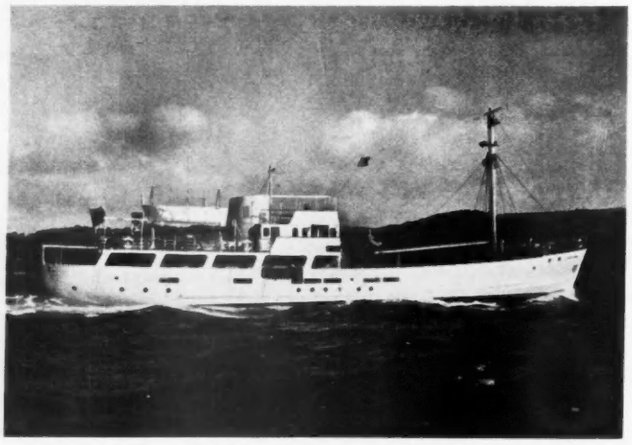


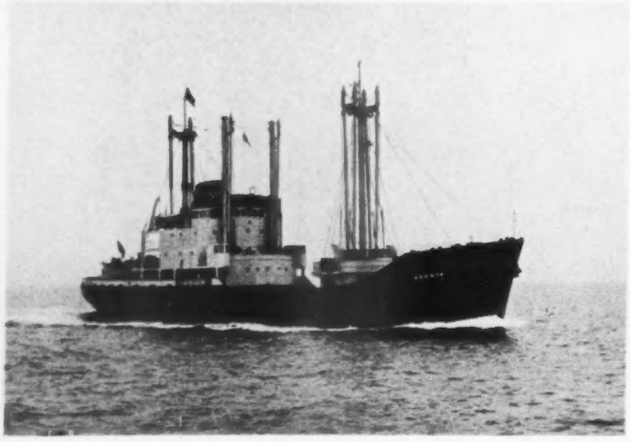
Harland and Wolff, Ltd., delivered to Coast Lines, Ltd., the cross-Channel passenger and cargo vessel "Scottish Coast" with cabin accommodation for 246 first class and 144 second class passengers. The ship, described in "The Engineer" of March 15, has a length between perpendiculars of 324ft, a beam of 51ft 6in and a depth of 19ft 9in, a bow rudder and Denny-Brown stabilisers. Electrical demands are met by three 250kW diesel-driven generators and the ship is propelled by two Harland-B. and W. trunk-piston two-stroke diesel engines, each having ten cylinders of 500mm diameter by 900mm stroke.

Below is the lighthouse and buoy tender "Salama," built by Philip and Son, Ltd., for the Government of Zanzibar, which has a length between perpendiculars of 135ft by 28ft beam by 13ft in depth and has an 8-ton derrick to handle buoys. For propulsion there are two British Polar diesel engines each developing 310 b.h.p at 340 r.p.m.

Immediately below is the cargo ship "Koonya" built by Henry Robb, Ltd., for the Union Steam Ship Company of New Zealand, Ltd. A deadweight of 1950 tons is carried on 14ft 7in mean draught and the following dimensions ; length between perpendiculars 235ft, breadth 45ft and depth to upper deck 16ft. There are two large holds, served by eight 5-ton derricks operated by eight electric winches; three 114kW diesel-driven generators supply the power for deck machinery and auxiliaries with one 15kW generator for port use. Propelling machinery consists of an eight-cylinder British Polar two-stroke diesel engine developing 1280 b.h.p. at 256 r.p.m.

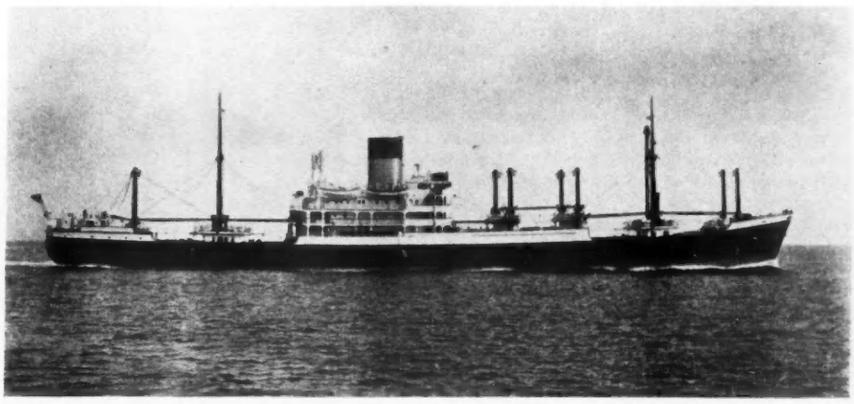
Below to the right is the open shelter cargo ship "Sandpiper" owned by the General Steam Navigation Company, Ltd., and built by Henry Robb, Ltd. The main dimensions are:—length between perpendiculars 215ft, breadth 36ft 6in, depth to upper deck 20ft 6in. The ship carries a deadweight of 1000 tons on 12ft 10in mean draught. One 15-ton and six 5-ton derricks are provided and six electric winches. The ship is propelled at 12·5 knots by an eight-cylinder British Polar diesel engine developing 1280 b.h.p. at 250 r.p.m. and electrical power is supplied by three 80kW diesel-driven generators

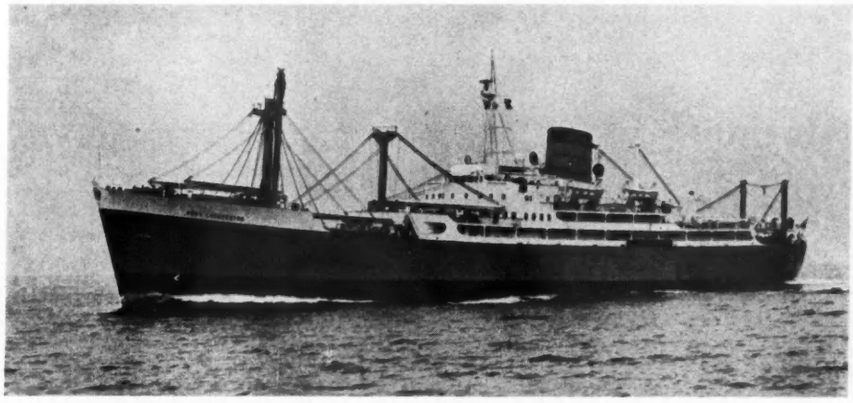




Cargo-Passenger Ships

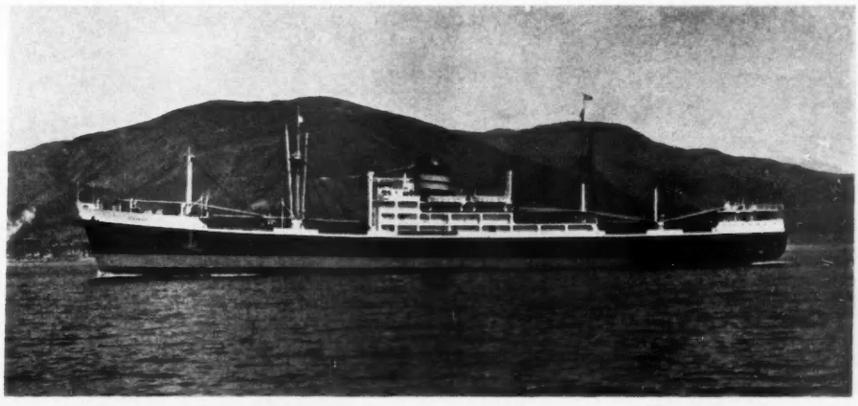
The "Menelaus," the first of a new class of cargo-passenger liners, was completed by the Caledon Shipbuilding and Engineering Company, Ltd., for the Blue Funnel Line. There is accommodation for twelve passengers and the main particulars are: length between perpendiculars 455ft, breadth 65ft, depth to upper deck 36ft, draught 28ft 10in, cargo capacity 56,9200 cubic feet, service speed 16·5 knots. One 35-ton, two 15-ton, six 10-ton and eighteen 5-ton derricks serve six holds. Electric power is developed by two 450kW diesel-driven generators and the ship is propelled by a Harland and Wolff six-cylinder, turbo-charged opposed-piston diesel engine developing 8500 b.h.p. at 115 r.p.m.

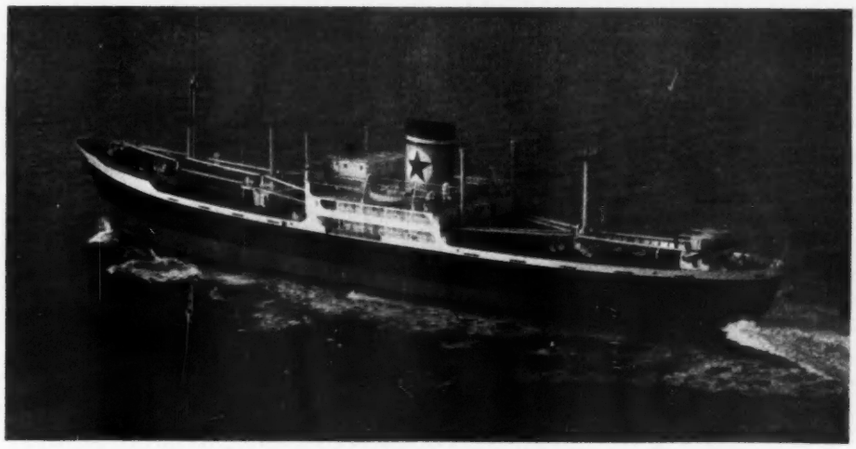




Harland and Wolff, Ltd., completed, at Belfast, for the Port Line, Ltd., the cargo and passenger liner "Port Launceston," which has a length overall of 490ft, a length between perpendiculars of 460ft, a breadth of 65ft 6in by 41ft 6in depth to upper deck and a gross tonnage of 8950. There are cabins for ten passengers. The five main cargo holds, some of which are insulated, are served by one 70-ton, four 15-ton, four 10-ton and six 5-ton derricks, powered by electric winches, and a 3-ton electric crane. Subdivision is by seven watertight bulkheads and there are three complete steel decks. A single-acting, two-cycle Harland and Wolff opposed piston diesel engine, having seven cylinders of 750mm diameter by 2000mm combined stroke, is the main propulsion unit and three 360kW diesel-driven generators meet the demand for electrical power

The Clan Line Steamers, Ltd.'s, "Ayrshire" built by the Greenock Dockyard Company, Ltd., has accommodation for twelve passengers and carries a deadweight of 11,230 tons on 28ft 3in draught, and the following dimensions: length between perpendiculars 497ft, breadth 69ft and depth 41ft 7in. The six holds have a capacity of 600,000 cubic feet, including 378,000 cubic feet of refrigerated space and the cargo is handled by one 105-ton, two 40-ton, four 15-ton, four 7-ton and twelve 5-ton derricks, and twenty 5-ton electric winches. There are four 300kW diesel-driven generators. The service speed of 17 knots is maintained by a single set of triple-expansion, double-reduction geared Parsons reaction turbines, developing 10,500 service s.h.p. at 112 propeller r.p.m. Steam is supplied at 415 lb per square inch and 750 deg. Fah. by two Babcock and Wilcox boilers

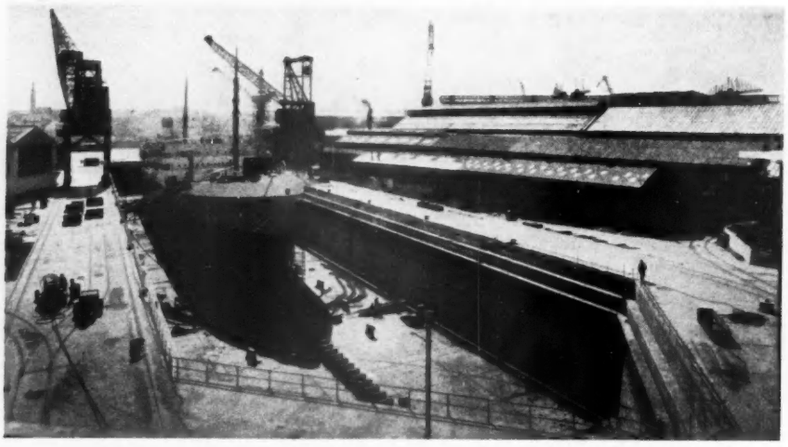




The Blue Star cargo-passenger liner "Canadian Star" was built by The Caledon Shipbuilding and Engineering Company, Ltd., and is designed to operate as either an open shelter deck or closed shelter deck ship. Accommodation is provided for twelve passengers and the ship has a length overall of 473ft 3in by 63ft beam by 39ft depth to shelter deck. The deadweight in open shelter deck condition is 9460 tons and the service speed is 15½ knots. A complement of one 50-ton, six 10-ton and ten 5-ton derricks, powered by electric winches, serve the five cargo holds, which are fitted with Macgregor steel hatch covers. Four 200kW diesel-driven generators provide electric power and the ship is propelled by a Scott-Doxford six-cylinder, opposed piston, single-acting, two stroke oil engine developing 8000 b.h.p.

Docks and Harbours

The dry dock for Swan, Hunter and Wigham Richardson, Ltd., at Wallsend on Tyne, was opened on May 14. It is 715ft long, 105ft wide at the entrance, and has 29ft water depth over the sill at H.W.O.S.T. It is built in mass concrete, a choice dictated by the difficulties of the site. A deep-well pumping system controlled ground water during construction. Twelve wells were sunk to a depth of 90ft, and pumping rates reached 1000 g.p.m. Ship-repairing services at the dock are comprehensive, and it is closed by a flap gate. It can be emptied in two and a half hours, and has an anti-syphonic discharge arrangement. Consultants: T. F. Burns and Partners. Contractor: Sir Robert McAlpine (Newcastle upon Tyne), Ltd.



The first part of a planned development of the port of Aden is now nearing completion; its estimated cost is £3,200,000. The development is to consist of dredging and reclamation, a revision of moorings, and the construction of wharves. Here we show reclamation at Maala, construction of the Lighter Cut in the lower foreground, and of the Import Quay in the centre ground. The latter is 827ft long, with 20ft of water alongside; its height is 37ft 6in, and it is built of tee-shaped mass concrete blocks, the heads of the tees forming the back of the wall. The existing Maala wharf can be seen to the right of the centre ground. Consultants: Sir Bruce White, Wolfe-Barry and Partners. Contractors: Pauling and Co., Ltd., Dredging and Construction Company, Ltd., K. L. Kalis, Sons and Co., Ltd.

Shoreham harbour: reconstruction was virtually finished in 1957, and colliers of 4500 tons can come into the harbour to serve the C.E.A.'s power stations. The lock on the left is new, and is 374ft long. Outer and inner lay-by wharves, 1680ft and 830ft in length, are in anchored steel sheet piles. There are three new breakwaters, which have been constructed of mass concrete, placed between lines of steel sheet piling, and the entrance channel has been widened and deepened. Existing structures have been realigned. Dredging totalled 1,100,000 cubic yards. The cost of the reconstruction has been about £2,000,000. Consulting engineers: Sir William Halcrow and Partners. Contractor: Peter Lind and Co., Ltd.

abandoned the rescue bell as a method of escape from the smaller type of submarine. During the summer months, H.M.S. " Cumberland "—the Navy's trials cruiser—continued the series of investigations in progress in 1956. These included the testing of various systems of " pre-wetting " (the method of washing a ship suspected of contamination by radioactive fall out) ; and the testing of the new 3in and 6in fully automatic guns now being developed. The rate of fire of the new 3in gun is equal to that of a heavy machine gun.

Dockyards and Maintenance

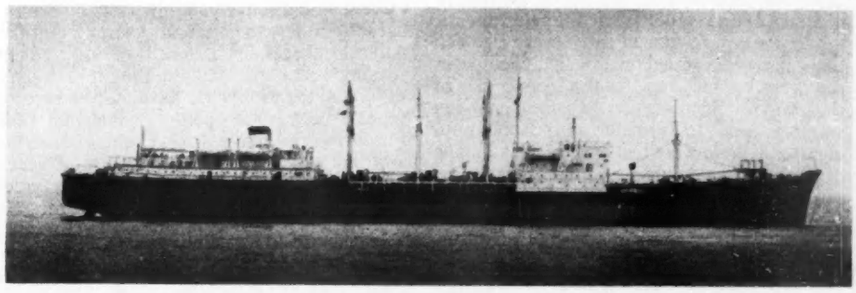
The net amount approved by Parliament for the current Navy Estimates was £316 million, a decrease of nearly £33,000,000 on the final total of £348,840,000 approved for the 1956-57 naval budget (which included the Supplementary Estimate for Suez). The reduction is more drastic than it appears because of the higher prices for materials and transport and the increases in salaries, wages and pensions. Nearly two years ago the Admiralty set up a committee with the object of reducing and concentrating the shore support of the Navy, both naval and civilian, to ensure that as much money and manpower as possible can be made available for the sea-going fleet. Up to date, as the result of the Committee's recommendations, three large establishments, ten medium sized and twenty-three small ones have been or are in the process of being closed down. A further six large, twenty medium and thirty-eight small establishments are to be closed by 1960. These include the Experimental Establishment at Perranporth, the Material Laboratory at Holton Heath, the Underwater Launching Establishment at Bournemouth and a number of Naval Armament, Boom Defence and Shore Depots. Elementary specialist training is in future to be carried out as far as possible at sea and the Royal Naval Barracks are to become mainly training centres. Harwich is no longer to be used as a naval base and, apart from the training ship " Ganges," all the naval establishments there are to be closed down.

In conformity with the changes and reductions in the Navy's shore support, adjustments of the Works programme have already been made on a substantial scale, and the First Lord gives warning of the probability of having to stop or curtail a number of projects in the current programme. Priority, however, is being given to the improvement and replacement of sub-standard accommodation for officers and men of the fleet and to the provision of married quarters. One thousand four hundred married quarters are expected to be completed during the current financial year, compared with 980 last year. The money voted under the Armed Forces Housing (Loans) Bill is mainly being expended in the building of houses and flats at the Home Ports. Subject to modification as may be necessary under the present review of shore support, £6,000,000 is provided for the Royal Dockyards in the current programme, and it is intended to start further projects costing £1,250,000 by March 31. At the present time 85 per cent of the work on naval ships, other than new construction, is carried out in the Royal Dockyards. So long as there is a programme of repair, refit, modernisation and conversion which will keep the Royal Dockyards fully employed, there would be no saving by closing any down, and rumours that this or that dockyard will be closed should be discounted. The current reorganisation of naval forces and of their shore support has, however, considerably modified the usefulness of our dockyards overseas. The future of Malta dockyard is still under consideration, but the Government has now decided to close down Hong Kong dockyard by the end of next year. Facilities will be retained there for servicing and operating a small naval force of a frigate or destroyer and six inshore minesweepers which will be based at that port.

The policy continues of reducing the number of ships in the Reserve Fleet and maintaining the most effective of those that remain in a high state of readiness, the others being sold to friendly navies or scrapped. Reserve Fleet ships will thus not only be ready for sea at very short notice in a nuclear war, but are immediately available in peace time to replace a vessel in the Active Fleet which is damaged or withdrawn for refit or modernisation.

Despite the increasing importance attached to afloat support, the need for economy seems to rule out the provision of more Royal Fleet Auxiliaries at the present time. The light fleet carrier " Triumph " is to be converted into a heavy repair ship, but the current afloat support programme is otherwise limited to the modernisation of existing ships. The aircraft maintenance ship " Perseus " will not, as previously decided, be converted to a submarine depot ship. The R.F.A. Service comprises tankers, store issuing ships, tugs and salvage vessels, manned by Merchant Navy officers and men and flying the Blue Ensign. Included in the tanker fleet are the three " Tidereach " class, built since the war—18-knot ships of 17,700 deadweight tons for transferring food, stores, ammunition and oil to ships under way. Apart from keeping alive the techniques of under way replenishments, these fast replenishment ships—and the oil freighters—carry the Admiralty's supplies of fuel from source and distribute them to the Admiralty oil depots at home and overseas. It is of interest to note that the personnel employed in the nuclear tests in the Christmas Island area have been entirely dependent on R.F.A. ships—mainly the " Fort " class supply ships and the " Wave " class tankers—for their supplies of food, water fuel and other essential requirements.

A scheme for the pooling of servicing craft—including tugs, launches, pinnaces, barges and lighters—has now been introduced to achieve economy in the number of craft required and in their operation, maintenance and repair. The control of these craft has hitherto been divided at each major port among the various authorities who use them. Apart from the dredging fleet, they will all in future be brought under one control and will be centrally repaired and maintained. They will be known as Port Auxiliaries and their personnel will be organised as a Port Auxiliary Service and be interchanged as required. It has also been decided to concentrate naval research and development establishments in the two spheres of above-water and underwater weapons. Other establishments dealing with basic and other forms of research will not be affected. The Admiralty Gunnery Establishment at Portland, employing some 500 personnel, is to be moved to Portsdown, Hampshire. Its work on naval gunnery will be amalgamated there with the radar work done by the Admiralty Signal and Radar Establishment, thus enabling weapons and their control systems to be developed together. It is, however, intended to continue using the facilities of the Portland Firing Range. The Underwater Countermeasures and Weapons Establishment at Havant and the Underwater Launching Establishment at Bournemouth are to be moved to Portland, where Underwater Weapons Research and Development Establishments will be concentrated in the existing Underwater Detection Establishment and in the buildings vacated by the Admiralty Gunnery Establishment. It will probably be 1960 before the complete scheme can be carried through. A decision has still to be made on the future of the Torpedo Experimental Establishment at Greenock, which is an integral part of the Underwater Weapons Research and Development Organisation.



The R.F.A. " Tidereach." Fleet replenishment ship—15,000 tons, 18 knots

Personnel

Vote A provides for a maximum strength of 121,500 on April 1, 1957, and for a reduction during the current year of 7000. This is the first step towards implementing the new defence policy which will result in reducing the Royal Navy's manpower to a figure between 100,000 and 90,000 by 1962. The major part of the reductions will be effected in 1958 and 1959, but the process will continue throughout the whole five-year period. Just under 2000 of the present strength of 14,000 officers will have to be prematurely retired—about equal to the natural run down over the same period due to the disappearance of the National Service Officer and normal retirements for age. The required reduction in the strength of ratings will also be achieved by stopping the National Service entry and by the normal termination of engagements, but about 950 will have to be compulsorily retired (confined to men with over seventeen years' service). The compensation scheme for those to be compulsorily retired has been well received. A Commander R.N. retired at forty-five after twelve years' service, for example, will receive a special grant of £3500 in addition to the normal pension of £800 and a terminal grant of £2400. A Petty Officer retired at thirty-five after eight years' service in that rank gets a special grant of £1250 with his normal pension of £1 18s. 10d. a week and terminal grant of £174 increased to £2 12s. 7d. a week and

£225 respectively. All grants are tax free.

The new engagement structure for ratings and other ranks (replacing the special service seven-year and the continuous service twelve-year engagements with an initial engagement of nine years) and the new pay code have now been in force for nearly two years. Both re-engagements of special servicemen and re-engagements for pension have since been very satisfactory and, in spite of the higher standards for recruits recently introduced, recruiting both for the Royal Navy and the Royal Marines has also considerably improved. There is still, however, a serious shortage of artificer apprentices, signalmen and telegraphists.

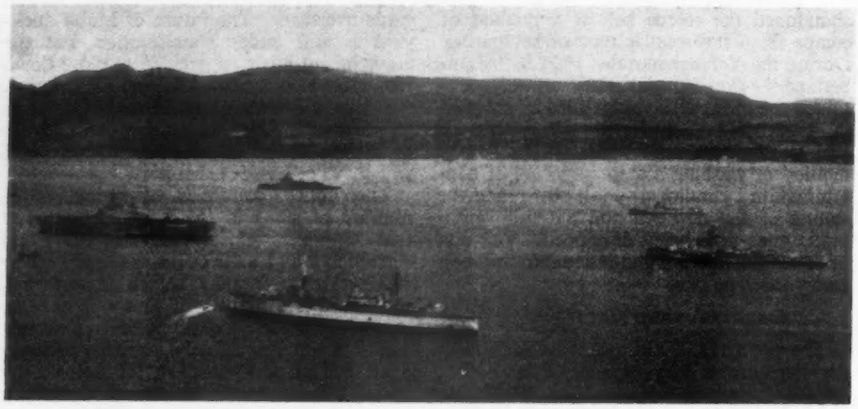
The new General List for officers, replacing the separate entry for Executive, Engineering, Supply and Secretariat and Electrical branches has now been in force for a year. The former Branch List (previously called Warrant Officers) has now become the special duties List and a Supplementary List has been introduced for air crew and electrical officers to replace the former short service commissions. Officers of the former non-executive branches thus now receive wider powers of command and more varied appointments. Under the new scheme of entry at age eighteen there has been an average of five candidates for every vacancy, and in the second year of the Naval Scholarship Scheme—enabling suitable lads to remain at school until eighteen—there were 830 applications for the ninety places available. Common entry for service in all specialisations of the General List was introduced in May. Entries are allocated to the various branches after one year's training at Dartmouth. Young officers now join the fleet from Dartmouth at the age of twenty or twenty-one as Acting Sub-Lieutenants and, from May 1 of last year, midshipmen ceased to serve in seagoing ships, thus bringing to an end a tradition of nearly 300 years. A further important change introduced during the year was the change-over for pilots and observers from four and eight-year short service commissions to twelve-year commissions on the Supplementary List. Pilots and observers are of course also provided from the General List. Promotion to commissioned rank through the Upper Yardman Scheme continues as part of the new officer structure, but their training is to be broadened to enable them to take their full place in the new General List.

The reduction and reorganisation of the Reserve Fleet to meet the changed conditions of a future war has resulted in drastic reductions in the various reserve forces. The Royal Fleet Reserve—all fully trained—is being reduced from 33,000 to 5000 men, and the Royal Naval Reserve—Merchant Navy personnel—and the Royal Naval Volunteer Service—who are civilians—have now been formed into a single unified structure called the Royal Naval Service. This will simplify administration and will give added strength to the Navy's volunteer reservists. The training of reservists belonging to the Merchant Navy and Fishing Fleet will not be affected ; the training of other reservists of the Unified Reserve will in general involve attendance at the existing R.N.V.R. Sea Training Centres on week-nights with periods of continuous training at sea. A new Naval Discipline Act has been passed, abolishing the death penalty except for offences committed with intent to assist the enemy, and providing for all officers on the General List to be eligible to sit on courts-martial.

Exercises and Operations

Up to 1957 the main object of the combined exercises carried out by the N.A.T.O. navies was to improve co-operation in the vital task of defending the sea communications. During the past year, however, the scope of the exercises has been widened, culminating in the autumn in a series of five major exercises—collectively known as "Strikeback"—to test the retaliatory strength of the Atlantic forces in defence of the North Atlantic areas and entailing the rapid organisation of the N.A.T.O. naval forces after a general alert. The operations included Task Force replenishment at sea, anti-submarine and air defence, weather and intelligence reporting and the co-ordination of forces by command headquarters. It is regrettable that at the conclusion of the exercises, the considered view of both the R.N. and R.A.F. Commanders of the Eastern Atlantic—an area in which Britain has special responsibilities—was that they could not carry out the tasks given them without more and better equipped maritime forces.

Other N.A.T.O. exercises included a six nation minesweeping and anti-E-boat exercise in the southern North Sea—in which the naval forces of West Germany took part—and an exercise in the Mediterranean to test the defence of sea communications which involved widely dispersed surface and air operations by units of the French, Greek, Italian, Turkish, British and United States naval and air forces. This latter exercise was followed up by a combined amphibious assault exercise in which Royal Marine Commandos and United States Marines attacked and landed on Scandinavia. The Royal Navy also carried out combined exercises, as in previous years, with the Royal Australian, Royal New Zealand, Royal Ceylon and Indian navies. The peace time activities of the Royal Navy included an inspection by H.M. The Queen in Cromarty Firth and a visit by the "Ark Royal" and two "Daring" class ships to Hampton Roads, to represent Great Britain at the International Naval Review.



The "Eagle" and other R.N. ships assembled at Greenock for N.A.T.O. exercise "Strikeback"

Scientific Developments in 1957

By SIR ALEXANDER FLECK

Upon his installation as president of the British Association for the Advancement of Science for 1958, *Sir Alexander Fleck reviewed the scientific developments of* 1957. *We reproduce his speech almost in full here, because engineers played a part in making nearly all the advances to which he referred. Finally, he referred to steps the Council of the Association is taking to set up area committees and to gather together panels of speakers able to "put across" science to general audiences and to young people.*

The International Geophysical Year

THE year 1957 is strongly associated in the minds of many followers of science with the beginning of the International Geophysical Year, and it is therefore appropriate that I should refer in my opening remarks to the geophysical events which have taken place during the last year.

The advancement of technology has probably never been so clearly demonstrated to the whole world as when the first artificial earth satellite was successfully launched from Russian soil early in October. The appearance of something which could be described as a "new moon" was a technical achievement which those on this earth, with almost negligible claims to literacy, could appreciate, and which captured the imagination of the British public to a remarkable extent.

This event, closely followed by the launching of "Sputnik II," dominates the I.G.Y., and is the first experiment of a type which will undoubtedly add to man's knowledge of space much that our atmosphere has prevented us from discovering before. It should not, however, detract from the other advances which have been made in the study of conditions beyond the outer confines of the atmosphere. Some of these events can at present only be assessed as technical achievements — the American - manned balloon which reached a height of 20 miles ; the rocket which soared to some 4000 miles[1] ; the aluminium pellets,[2] some of which are surmised to have been consumed by the sun. So wide is the concept of these explorations that it will be some time before their results can be properly appraised from a scientific point of view. Already, however, some of the more far-fetched, but nevertheless fundamental implications of these experiments are being discussed, for we find eminent students of relativity theory debating in the

pages of *Nature*[3] how quickly potential passengers in rocket flights are likely to age during their journeys into space.

There is one science in which the British contribution to the I.G.Y. has been of paramount importance during 1957, and that is radio-astronomy. At Jodrell Bank, Professor Lovell has been obtaining the first results from the largest steerable pencil-beam type of radio-telescope in the world ; its adaptability was demonstrated by the way in which it was improvised to detect echoes from the Russian satellites, which it very successfully tracked. Recently it has been trained on more distant sources, and its use will undoubtedly add much to our knowledge of interstellar gas,[4] radio-stars and solar flares. In this connection, a special tribute is due to the sun, whose contribution to the I.G.Y. has been a great output of sunspot activity.

The other notable British achievement in radio-astronomical research has been the construction of the new interferometers[5] at Cambridge. One of these instruments is intended primarily for the study of radio-stars and another will be used to investigate continuous radiation from our Galaxy. By these techniques, Mr. Ryle[6] hopes to penetrate further into the outer reaches of the Universe than ever before, and thus to throw more light on one of the central controversies of cosmology, whether we live in an " evolutionary " or " steady-state " Universe.

Against these highlights there is a story of concerted effort in almost every country to find out more about the earth and the sun.

In his Presidential Address to the Association in 1951, H.R.H. The Duke of Edinburgh referred to the development of team work which had contributed so much to science during the previous 100 years ; seldom has this been so well epitomised as in the geophysical research of 1957. Oceanographers, polar explorers, glaciologists, meteorologists, nuclear physicists, seismologists, astronomers are all combining their contributions to the structure of our knowledge ; but we shall not be able to see their work as a whole until 1957 is further behind us, and the meaning of their results has been thoroughly comprehended.

Nuclear and Theoretical Physics

It is probably in the field of nuclear and theoretical physics that the next most significant advances have been made. The award of the Nobel Prize for Physics to Yang and Lee has called public attention to the law of conservation of parity, the universality of which was disproved early last year at the National Bureau of Standards[7] in Washington and at Columbia University. Parity is concerned with the kinematics of groups of fundamental particles, and its conservation in nuclear transformations was assumed until rather more than a year ago. I merely point to the importance of constantly questioning the validity of our beliefs concerning natural phenomena, even when they have sufficient respectability to be called " laws." However, I must tread very delicately over these and similar provinces of the specialist.

The discovery of the 102nd element, nobelium, is another announcement made during 1957.[8] It is the first man-made element to be discovered in Europe, and it provides another instance of international team work in scientific research, for British, Swedish and American[9] scientists all participated.

The method of preparation was to bombard curium–244 with nuclei of carbon–13, which were accelerated in the 225cm cyclotron in Stockholm. Since the half-life of the resulting isotope was only about ten minutes, considerable ingenuity was required to identify it. Those of us who are chemists will be particularly interested in the properties of any more new elements that are discovered, for we may soon find ourselves exploring a new period in the Periodic Table.

Several significant events have occurred in this country during 1957 which relate to the production of energy. The Harwell nuclear reactors known as " Pluto " and " Neptune " have both[10] been started up, and we can expect that the latter will provide much valuable information about the design of reactors for marine propulsion ; the need for careful design has been only too strongly underlined by the Windscale accident.

Of more far-reaching significance, however, is the brief announcement that Dr. Thonemann's team at Harwell have apparently succeeded in conducting a controlled thermonuclear fusion in their quartz torus, known as " Zeta " II.[11] This type of reaction provides the energy of a hydrogen bomb explosion, and of the sun, and if it can be made self-sustaining in the laboratory it is likely to have a major effect on power production later in this century. The energy put into the Harwell apparatus was concentrated by electric and magnetic fields so as to produce a temperature of the order of 5,000,000 deg. Cent.,[12] and it has been calculated that a ten- to twenty-fold increase would probably be required before nuclear fusion would be self-sustaining. As conducted, the experiment gave detectable quantities of neutrons, which are believed to have been formed as a result of the fusion of some of the deuterium atoms which the apparatus contained. This is a piece of pioneer work, the implications of which we can now only see darkly ; but in the lifetime of some of us we may see them face to face.

Chemistry

In considering the production of energy, I should also mention the development of chemical rocket fuels. Here the requirement is a stable material which will burn evenly to provide a large amount of energy per unit volume or weight. Of course, the military implications of advances in this field make them more the subject of speculation than of informed comment, but it has been announced that plants are being constructed in the U.S. to produce boron compounds for this purpose. The boron hydrides,[13] which, with fluorine, fulfil the requirements of a rocket fuel, are thus gaining importance for reasons other than their enigmatic chemical structure, in which the boron atoms appear to be tetravalent instead of trivalent. It is a matter for conjecture whether the Sputnik rockets were powered by a fuel of this sort.

Before leaving the field of inorganic chemistry, I ought to allude to the production of synthetic diamonds by General Electric in America. Whilst previous claims to have synthesised diamonds have been made, no large industrial undertaking has so successfully devoted research to the project, nor has the development of a commercial process become so far advanced as in 1957. For strategic reasons the U.S. Government has suppressed the details of the process as contained in the covering patent, but it is at least evident that very high pressures of over 1,000,000 lb per square inch are probably used in conjunction with temperatures of the order of 3000 deg. Cent.[14] The size of the resulting diamonds is small, yet some are large enough for industrial applications.

In other fields of chemistry, developments during 1957 have been mainly concerned with the continuation of long-term researches, and it would be inappropriate to single out particular discoveries from each developing subject. One such research programme is the study of nucleotides, which is proceeding at Cambridge under the direction of Sir Alexander Todd. His work has this year been honourably recognised by the award to him of the Nobel Prize for Chemistry.

Conclusion

These are a few items on the line of active development and it will be interesting to see how they progress during 1958. The list is far from being exhaustive, but it is, I believe, enough to show that our science is very much alive and that it will continue to penetrate into the daily lives of our peoples.

None of us, I feel, need any convincing that in the present setting the Association has one of its most important tasks in getting more and more people of these islands to realise the vital importance that science is to them. That is the broad task to which our council has once again affirmed its resolve and for which our support is required and, indeed, is demanded.

I have very briefly sketched what to me is a wealth of exciting scientific achievement and thought, and I feel that, properly handled, such achievements can be made to compel the interest of the young people of Britain to the furtherance of the scientific ideal. To work for this end the Council of our Association is initiating two steps which will be integrated with each other and both should proceed simultaneously by methods which our secretarial organisation will in due course indicate. They will help to develop our inter-meeting activities. The two steps which are proposed are, first, Area Committees, and then a panel of speakers. Area Committees would seem to be essential for the whole country to make local arrangements for lectures, exhibitions, and so on. The effectiveness of such activities will very largely depend on the effectiveness of the Area Committees. And so I express the hope that keen members of the British Association will play an active part in running them. The second piece of organisation is the formation of a panel of lecturers. We think such a panel must be large—more than a hundred—and its essential characteristic is that its members should be able to put across science to general audiences and to young people. The gift of interpretation is not given in equal measure to all of us, but to those who have it in good measure, I appeal to join the panel and to play a part in the interpretation of new discoveries. Given some basic understanding, experience tells us that the capacity to speak in simple terms is an art that can be cultivated, and so judicious cultivation may well be like the quality of mercy, twice blessed—to those who give not less than to those who receive. I hope the Association will receive wholehearted support in this vital task.

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[2] *The Times*, November 23, 1957, page 6.
[3] *Nature*, 178, 680, and 177, 782 (1956).
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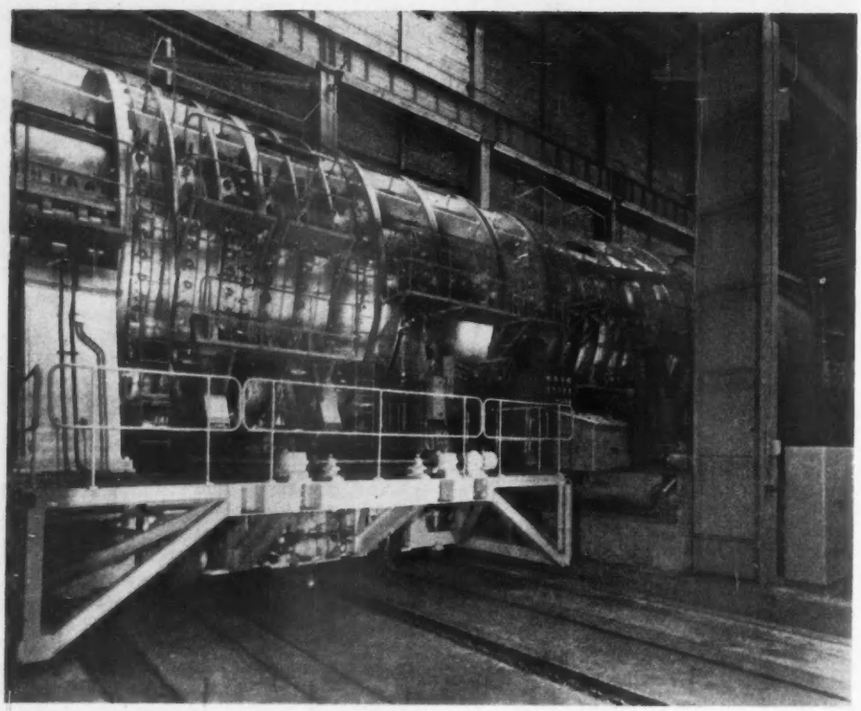
Electrical Engineering in 1957

No. II—(*Concluded from page 22, January 3*)

MODERN practice in large electrical drives with accurate speed control is well exemplified in the 8ft by 8ft high-speed wind tunnel at the Royal Aircraft Establishment, Bedford, which was opened last June by the Minister of Supply.

This wind tunnel is designed to operate up to Mach 2·7, at pressures from 0·1 to 4 atmospheres. It has a maximum diameter of 47ft and measures 350ft between long centres and 60ft between short centres. Air is circulated in the tunnel circuit by an English Electric ten-stage axial compressor driven by a 68,000 h.p. a.c. motor which is backed by two 6000 h.p. d.c. motors for accurate speed control. Two 20MW gas-turbine alternator sets in an adjoining generating station provide a variable-frequency supply for the a.c. motor.



8ft by 8ft wind tunnel at Royal Aircraft Establishment, Bedford. The high-pressure section on the left is removable, being mounted on an electrically driven truck

The compressor is designed to produce a maximum air flow of 50,000 cubic feet per second, or 102 tons per minute, at 750 r.p.m., absorbing 80,000 h.p.—a figure which can, ultimately, be raised to 100,000 h.p. It consists of a four-stage, fixed low-pressure section and a six-stage movable high-pressure section. The high-pressure section is mounted on a truck (as illustrated), so that it can be removed from the wind-tunnel section and replaced by a dummy section for certain aerodynamic conditions. To carry out this change, the pressure behind the hydraulically-operated moulded rubber casing seals at either end of the stator section is released and the dog-type coupling between the high-pressure and low-pressure shafts withdrawn towards the high-pressure end by a hydraulic motor. A 3 h.p. motor then operates through reduction gearing to remove the truck carrying the high-pressure section and insert the dummy section in the tunnel. Pressure is then applied to the seals, the whole operation of changing the movable section being completed in twenty minutes. The casings of both sections of the compressor are split along the vertical centre-line and, after removal of the joint bolts, the two halves can be withdrawn on rails to expose the blading and bearings for maintenance.

The compressor is driven by a composite main drive, which is illustrated opposite, and consists of an English Electric 68,000 h.p., 11kV, 750 r.p.m. synchronous motor, and two existing series-connected d.c. motors, each 6000 h.p., 600 r.p.m., 750V. The d.c. motors are coupled to the 68,000 h.p. synchronous motor through a David Brown helical gearbox. Further shaft extensions from the gearbox provide drives to the main lubricating oil pumps and to a reference tacho-generator. Barring gear is fitted at the tail end of the drive and can be connected through a clutch to turn the complete drive at the very low speed of one-tenth r.p.m. during the cooling period after shut-down and to facilitate operation of the h.p./l.p. compressor coupling. A Ward-Leonard motor-generator set feeds the two d.c. motors. It consists of two existing d.c. generators driven by an English Electric 14,000 h.p., 11kV, 600 r.p.m. reactor-started synchronous motor.

The main drive is started up by evacuating the tunnel, running up to speed on the d.c. motors and synchronising the 68,000 h.p. motor to either the 50 c/s supply from the national grid or the variable-frequency supply from the gas turbine alternators. With the tunnel evacuated the two 6000 h.p. d.c. machines are able to reach 750 r.p.m. compressor speed. After synchronising the motor the tunnel is pressurised as required.

There are three methods of driving the main compressor. First, by the two 6000 h.p. d.c. motors alone, with automatic or manual speed control. Secondly, by the two d.c. motors together with the 68,000 h.p. a.c. motor supplied at 50 c/s from the grid to give a constant speed drive at 750 r.p.m. Thirdly, by the two d.c. motors together with the a.c. motor supplied from the gas-turbine alternator sets, giving a variable frequency of from 10 to 50 c/s and, consequently, a speed range of 150 to 750 r.p.m. Automatic or manual speed control is available.

Automatic speed control is effected by an electronic system, with magnetic amplifiers for current-limit control, and is stated to be capable of maintaining the main drive speed to within ±0·1 per cent of the set speed over the normal working range. The system can operate not only on the excitation of the d.c. generators in the Ward-Leonard system, but also on the fuel valves of the gas turbines driving the alternators, the two controls being co-ordinated to allow the gas turbines to follow up changes in load and speed.

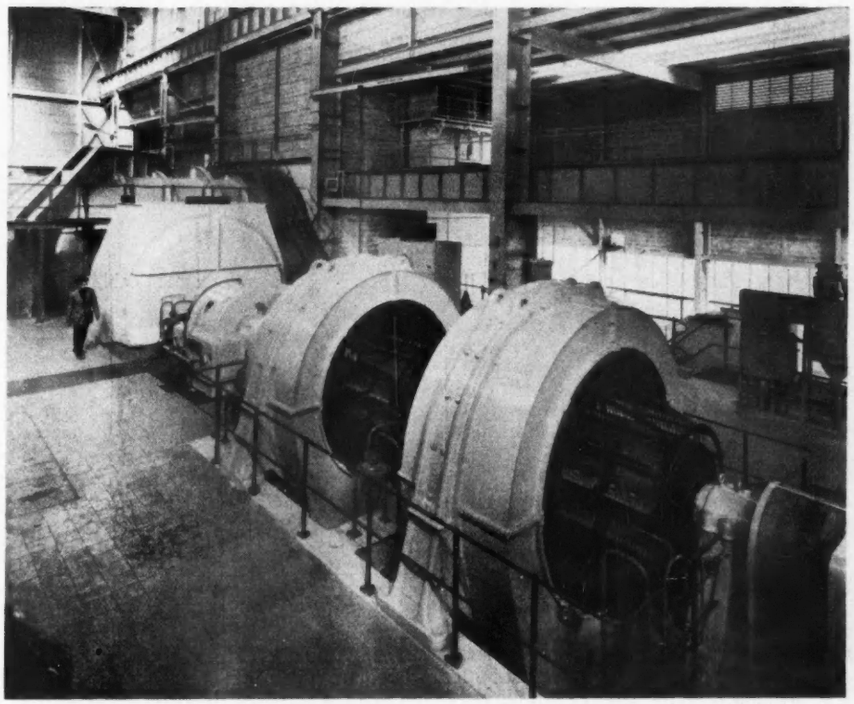
Transatlantic Telephone Cable

In an era when most of the spectacular advances in telecommunications have been in the field of radio it is instructive to recall the success of the transatlantic telephone cable, which completed its first year of operation on September 25, 1957. Before the cable was commissioned the telephone service was conducted by radio and the weekly average number of telephone calls was 530 between London and Canada and 2320 between London and the U.S.A. In the first six months of operation over the cable these averages had been increased to 1600 and 6420 respectively. These figures do not exhaust the capacity of the cable, for they do not include the traffic carried by the seven "through" circuits, which are leased to Continental countries—Germany (two), France, Belgium, Holland, Switzerland and Denmark—and which last year carried 130,000 calls directly to Canada or the U.S.A. In addition, there were about 2500 broadcast transmissions over the cable. A number of telegraph channels were also provided.

This increase in traffic is attributable mainly to the high quality and reliability of the cable service, which is immune from electrical storms and sunspot disturbances.

The rapid economic growth of Canada suggests a corresponding growth in transatlantic telecommunication traffic and the prospective needs were discussed last year at a meeting in Ottawa of representatives of the British and Canadian Governments, and Cable and Wireless, Ltd., and the Canadian Overseas Corporation. It was agreed in principle that a new submarine cable, incorporating recent technical improvements that would give it a larger carrying capacity than the existing cable, should be laid as quickly as possible between Canada and Great Britain. Accordingly, provisional plans were put in hand for a new telephone cable which was to be of advanced design, consisting of a single cable with two-way repeaters, to provide sixty telephone circuits.

Later, the American Telephone and Telegraph Company announced details of its scheme for the laying of a transatlantic cable between America and France. The scheme involves about 5000 miles of cable. Over 2200 miles of this cable will be made by Submarine Cables, Ltd., which is owned jointly by Siemens Ediswan, Ltd., and the Telegraph Construction and Maintenance Company, Ltd., and the rest will be shared



The main drive for the compressor in the 8ft by 8ft wind tunnel consists of an English Electric 68,000 h.p. synchronous motor and two 6000 h.p. d.c. motors

between Câbles de Lyon, in France ; Felten and Guilleaume, Carlswerk, A.G., in Germany, and Simplex Wire and Cable, in U.S.A. The deep-sea amplifiers will be made by Western Electric Company, in U.S.A. Amplifiers in the single cable across Newfoundland will be made by Standard Telephones and Cables, Ltd., at North Woolwich, England. Laying of the cable is to be done by the " Monarch " and the " Ocean Layer " in the summer of 1959. The link is scheduled for service in late 1959. It will provide thirty-six voice circuits at the U.S. end, with thirteen terminating in Paris, thirteen in Frankfurt, and ten in other European countries, to supplement the existing facilities, which consist of nine radio circuits and one cable circuit between France and the United States and twelve radio and two cable circuits between Germany and the U.S.

As in the case of the first project, the second will involve two cables of the same kind for the main crossing, one for each direction of transmission. This part of the system will again provide thirty-six telephone circuits and will be equipped with flexible one-way repeaters supplied by the Bell Telephone Laboratories of New York. The single cable for the Newfoundland–Nova Scotia link will use British Post Office rigid repeaters designed for sixty two-way circuit operation. The internal units, manufactured by Standard Telephone and Cables, Ltd., will be accommodated in steel casings supplied by Submarine Cables, Ltd

In its general design the cable resembles the first transatlantic cable. The inner core consists of polythene extruded over a central copper conductor composed of a 0·131in wire surrounded by three tapes 0·0145in thick. Over this core, which is 0·62in diameter, is applied the outer conductor consisting of a layer of six copper tapes applied with a long lay and held in position by a copper binder tape and a protective fabric tape, both applied with a short lay.

The jute serving, galvanised steel armour wires and the outer protective serving depend on the depth and sea bed conditions in the locality of laying. For the deep-sea cable, a layer of twenty-four high-tensile steel armour wires, each 0·086in diameter, is used, each wire being separately protected from corrosion by a coating of compound and an impregnated fabric tape before the wires are applied to the cable. The overall diameter of the deep-sea portion of the cable is 1·2in, with a weight of 3·1 tons per nautical mile in air and 1·9 tons per nautical mile in water. The depth of water over practically the whole of the Newfoundland–Nova Scotia section and for a considerable distance out from each of the terminal points of the main crossing is relatively shallow and this necessitates much heavier protection. Over 600 nautical miles of cable heavily armoured with twelve steel wires, each 0·30in diameter, is to be provided by Submarine Cables, Ltd. This cable has a diameter of 2·7in and weighs 26 tons per nautical mile in air.

As with the earlier transatlantic cable, great precision of manufacture and measurement is required. One consideration, for example, is that the attenuation of 2200 nautical miles of cable is approximately 1000 and 3600 decibels at the lower and higher ends respectively of the transmitted frequency band. But the transmission level at any frequency must be maintained so as to avoid overloading repeaters at high levels or running into interference at low levels. Consequently, the variation of attenuation with frequency must be accurately equalised at each repeater. Moreover, prediction of temperature and pressure at sea bed conditions is required, as the cable characteristics depend appreciably on both these variables. Another consideration is that the deep-sea repeaters do not include matching units, which means that their gain would be affected by irregularities of cable impedance due to reflections. Hence, manufacture must be stringently controlled to obtain as uniform a cable as possible.

Automatic Telephony

While the inter-Continental telephone service has been greatly improved by the commissioning of the transatlantic cable, the internal (or national) telephone systems are likely to benefit in the not-too-distant future by the introduction of automatic trunk telephony. The preliminary stage in this process has been reached in this country with the development of a new system of routing whereby exchanges will be grouped and all exchanges in any group will have the same charges. This simplification prepares the way for subsequent automation of the trunk service, with consequent economies in operation and administration.

The new method of routing is effected by equipment known as " GRACE " (Group Routing and Charging Equipment). In setting up a call this group routing and charging equipment does automatically what the trunk operator now does manually. In sequence it notes the number dialled by the caller, decides the correct route and charge rate, selects a route to the required exchange and, when the called subscriber answers, it records the charge on the caller's meter at the exchange. The equipment is in three main parts—call chargers, registers and translators. To make an automatic trunk call the caller dials the national number of the subscriber concerned. The first digit of all national numbers is " 0 " and when it is received by the exchange equipment it causes the call to be connected to a call charger. Then the call charger associates itself with a register which receives and stores the remaining digits, thus memorising this information during the setting up of the call. The first one, two or three digits received by the register identify the distant group. It is the function of the translator to inspect these digits and thereby deduce the route and the charge rate for the call. The translator is the " brain " of the system and it has a permanent memory which gives details of the routes and charge rates for calls from the originating exchange to all other groups in the country.

When the translator has examined the digits passed to it from the register, it identifies the exchange code, selects the appropriate route and charge rate for the call and then passes this information back to the register in the form of a charging rate digit and from one to five routing digits. To avoid the need for storage capacity in the register for all the digits simultaneously, the system provides that the digits should be passed to the register singly, as required. The register uses each digit to further the setting up of the call and then demands another specific digit from the translator. Any register needs more time to use a digit than the translator needs to supply it; the translator is, therefore, freed between successive demands so that it can be used by any other register needing its services.

The first digit returned from the translator to the register is used to select the correct charging rate in the call charger; subsequent digits are caused to operate switches in the originating and distant exchanges to complete the connection. Having completed the connection the register is released and made available for use with other call chargers in setting up further calls. Throughout the call the charger remains connected, and, when the called subscriber answers, it levies the charge by operating the caller's exchange meter at time intervals which depend on the distance between the groups.

Two forms of " GRACE " equipment are being developed ; one uses conventional electromechanical components such as uniselectors and relays, while the other uses electronic techniques. The electronic version

is being used in the first installation, at Bristol, where the equipment will consist, initially, of sixty-six registers and three translators (two of which will normally be in service, the third being a standby). It is designed to handle 6000 calls per hour, and to establish connection in each case within a few seconds of completion of dialling. "GRACE" has been devised by the British Post Office who developed the initial installation at Bristol in collaboration with The General Electric Company, Ltd., Magnet House, Kingsway, London W.C.2. The system was described in greater detail in our issue of November 22, 1957, page 758.

Another development of this kind is illustrated here. Our picture shows a rack of electronic equipment and the associated magnetic drum storage which now controls the internal telephone system throughout the research organisation of B.T.R., Ltd.,

Part of the telephone exchange controlling the internal telephone system of the B.T.R., Ltd., research organisation at Taplow Court. An electronic rack and magnetic drum memory system can be seen here

(an associate of the Automatic Telephone and Electric Company, Ltd.) at Taplow Court, Taplow, Bucks.

B.B.C. Television's Coming of Age

In one-way, as distinct from two-way, communication, the year 1957 was memorable as marking the twenty-first anniversary of the first B.B.C. regular television programme. The history of this television service—beginning at Alexandra Palace and then extending its coverage, with five high-power transmitters, six medium-power and as many permanent low-power transmitters to serve 98 per cent of the population—is too recent and too well known to call for comment here. The prospect is at least as interesting as retrospect, and the most significant of current developments is that concerned with experimental transmissions in the u.h.f. bands, for it is to these frequencies, known as bands IV and V, that one must look in the quest for more "elbow room" in the already congested ether.

Accordingly, the B.B.C. has, for some time, been studying these bands, which were allocated to television at the International Radio Conference at Atlantic City in 1947, but which have not so far been used for television broadcasting in Great Britain. After some earlier laboratory work the B.B.C. began its first series of u.h.f. propagation measurements in 1955. The aim was to study propagation on frequencies between 470 and 960 Mc/s over distances typical of a normal service area and over longer distances to help in the assessment of co-channel interference. For the first tests, over the longer distances, use was made of Mullard transmitters modulated by square waves. These transmissions are still in progress.

In 1956 the long-distance measurements were followed by a series of tests to evaluate propagation conditions in a typical service area, using a transmitter at the Crystal Palace at 495 Mc/s, working into a Yagi aerial and radiating a peak power of 1kW over a fairly narrow beam when modulated with square waves; for some of these tests pulse modulation was used. The experimental work has now been completed and the resulting information about field strength contours and shadow and echo effects is being studied.

Further information was, however, required before it was possible to decide the best way of using band IV and V for television broadcasting. To collect this information, the B.B.C. has started a more elaborate series of experiments, using a high-power transmitter and radiating full television signals initially on 405 and later on 625 lines (C.C.I.R. standards), as described in our issue of November 29, 1957, page 797. For these tests, which have been planned by the B.B.C. in conjunction with the Television Advisory Committee and the British radio industry, the B.B.C. has installed at the Crystal Palace a 10kW peak-white u.h.f. vision transmitter and a 2½kW carrier power sound transmitter, manufactured by E.M.I. Electronics, Ltd. The vision frequency is 654·25 Mc/s, but the transmitter can be operated at any frequency in the range 470 to 960 Mc/s. The equipment is low-power modulated on both sound and vision channels and employs "Eimac 3K50000LF" klystrons in both audio and video final stages. These klystrons use three external cavity resonators and operate as linear amplifiers with a power gain of approximately 100. They are driven by a modulated amplifier stage operating with a cathode-modulated circuit. In this installation the sound and vision transmitters are installed side by side in a single bay.

The output of the transmitters is combined in a filter-bridge circuit constructed in rectangular section waveguide. The combined output is then conveyed to the aerial by an elliptical (12in by 6in) waveguide, made of 99·5 per cent aluminium in 12ft lengths. At the top of the television mast the waveguide is transformed into a 5in concentric feeder to take power to the four driving points of the helical aerial, the pole supporting the aerial being arranged to form the outer of the concentric feeder.

The helical aerial is made of ½in diameter copper rod and comprises four bays mounted one above the other on the same vertical axis, each having a linear height of five wavelengths. Each bay is fed at the centre, the helix being wound from the centre point of the bay in opposing directions to cancel the vertical component of radiation. In the four bays there is a total of forty-eight turns, each turn being approximately two wavelengths long. The aerial is mounted at the summit of the Crystal Palace tower, the centre line of the aerial being 691ft above the ground. The aerial has a power gain of 20, and after allowing for losses in the feeder and waveguide system, the effective radiated power of the vision signal is of the order of 125kW peak-white in the horizontal plane. Provision is made for de-icing the aerial by electrical heating.

At Crystal Palace, the band V transmitter is in operation for several hours a day radiating pictures on the 405-line standard. The pictures are the same as those radiated by the band I transmitter installed in the same building. Later on, pictures on 625 lines will be produced at Lime Grove from flying spot teleciné equipment supplied by Cinema-Television, Ltd., and will be sent over a specially equipped coaxial cable to the Crystal Palace.

Particle Accelerators

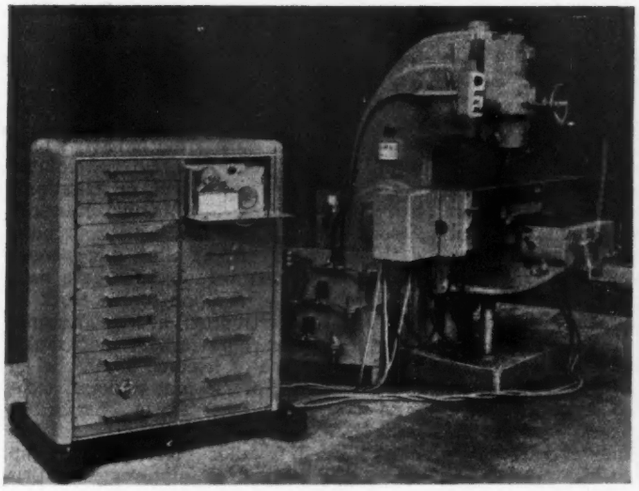
An interesting tandem particle accelerator is being designed and made by Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, in collaboration with the U.K. Atomic Energy Authority. This accelerator is to be used at the Atomic Energy Research Establishment, Harwell, and the Atomic Weapons Research Establishment, Aldermaston. It will help research into the nuclear properties of uranium and similar elements, and will enable energetic neutrons to be produced for other nuclear work.

The tandem accelerator is a development of the familiar Van de Graaff machine, but differs from it in that acceleration is achieved in two stages. First, negative hydrogen ions are accelerated from earth potential to an energy of 6MeV. They are then fired into a "stripper," which removes the electrons from the outer shells of the atom and leaves the ions still moving in a forward direction with a net positive charge but with energy almost unchanged.

The second stage of acceleration is achieved by bringing the positive ions back to earth potential, so that the total energy communicated to the ions is 12MeV. In this way, ions are accelerated to an energy twice as great as could be achieved in a single stage, whilst the insulation problems are exactly the same as in a single-stage machine for 6MeV. Generally, negative ions are more difficult to form than positive ions, and therefore the beam current in a tandem machine is smaller than in a single-stage machine, but this disadvantage is insignificant compared with the saving in insulation.

Considerable engineering problems are involved in the design and construction of a tandem generator of this kind. The generator is housed inside a pressure vessel 45ft high and 9ft in diameter, which contains an insulating belt mounted on pulleys some 16ft apart. The belt moves at 3000ft per minute, and electric charge sprayed on to its lower end is carried to the central terminal, where the charge is collected. The charge leaks back to earth through two potential divider chains, one going to the lower and one to the upper end of the vertical column. To reduce the danger of voltage breakdown, the spaces between the central terminal and the upper and lower ends of the column are each subdivided by 150 equipotential plates, connected to the potential divider chains at the appropriate tapping points. The accelerator tube is housed inside the "stack" of equipotential plates and passes right through the ends of the pressure vessel. The tube is subdivided by conducting rings, each connected to its corresponding equipotential plate, the aim being to limit the voltage across any one section of tube to 40kV.

Negative ions are formed in a high-frequency gas discharge and are withdrawn from the discharge by preliminary accelerating electrodes, which are designed to produce a focused beam of circular cross section and to fire this beam down the centre of the main



(Left) CVA Kearney and Trecker "2CES" vertical milling machine equipped with E.M.I. electronic control in two dimensions. It provides facilities for either linear or rotary machining, the latter by means of a detachable rotary table. (Right) The National Coal Board is using Marconi industrial television equipment at the Manvers coal preparation plant at Wath-on-Dearne, to aid plant control. On this monitor set the duty engineer can observe belt working and loading conditions on the coal input conveyor system

accelerating tube. Electrons are stripped from the negative ions by passing them through an extremely thin foil inside the central terminal. On emerging at the lower end of the accelerator tube the beam traverses a magnetic field adjusted to deflect the ions through a right angle and bring the beam to a focus on the particular target under investigation.

Operation of a high-voltage electrostatic generator necessitates "pressurising" the vessel containing the accelerating electrodes. In this case the gas pressure is 250 lb per square inch, and the weight of gas in the main pressure vessel is about 2 tons.

In this accelerator the ions may move distances of about 120ft before reaching their target, and the target area must not exceed a few millimetres in diameter. It is necessary, therefore, to maintain a very high vacuum throughout the entire ion path and accurately to control all the accelerating and deflecting fields. The accelerator tube is pumped at the top and bottom and, via a by-pass tube at the centre, by 14in mercury diffusion pumps with large dry-ice traps and liquid air traps in series. The accelerating, focusing and deflecting fields are controlled by electronic stabilisers to an accuracy of a few parts in 100,000.

The higher energies available from the new particle accelerators will permit the study of nuclear reactions produced by the bombardment of uranium and the transuranic elements, and a considerable advance in knowledge of the nuclear properties of these elements may be expected to result. By bombarding suitable light-element targets with beams of protons and deuterons, it will be possible to produce neutrons of controllable energy in the range up to 30MeV, and to study their interaction with other nuclei.

A 5MeV linear accelerator made by Mullard, Ltd., and installed at a Ministry of Supply establishment is believed to be the first of its kind to be designed specifically for industrial radiography. It is stated to give a radiograph of optimum definition, of a steel specimen 9in or 10in thick, with a 30 minute exposure. It has an output of 500 röntgens per minute at 1m, and the electron beam has a diameter of only 2mm when it strikes the target to produce the X-rays. The complete equipment is mounted on overhead rails and the transverse and longitudinal movements enable it to be brought within working range of anything to be radiographed on the shop floor. The whole equipment can be raised or lowered 8ft ; the accelerator can be turned laterally through 180 deg., and it can be tilted in any direction from the horizontal to vertically downwards. Finally, the X-ray head can be rotated.

Industrial Applications of Electronics

Of the many industrial applications of electronics we illustrate two on this page. The first is a CVA Kearney and Trecker 2CES vertical milling machine which has been specially adapted for electronic control in two dimensions by the E.M.I. system. It has facilities for either linear or rotary machining ; that is, the electronic control can be applied to the longitudinal traverse and either to the cross traverse or the rotary table, working with polar or cartesian co-ordinates, as required.

In the E.M.I. system of numerical or positional control design data are prepared in the form of a table of dimensions at a series of specific points in the part to be machined. These data are encoded on punched paper tape and are presented to the control unit, which first deduces the movements that should be made by the cutting tool and work table to produce the correct profile, and secondly, passes appropriate instructions to the servo controls of the machine.

The control unit incorporates a parabolic interpolator which enables it to deduce, from a relatively small number of "marker" points in the table of dimensions, a large number of other points lying on a smooth curve through the "markers." No separate computer is therefore required. Provision can be made for cutter radius compensation, so that re-sharpened cutters can be used without the need for a new tape. As position control is incorporated, each dimension is measured separately from the same datum point, thus eliminating accumulative errors. Further, provision can also be made for the cutter to be set manually at a datum point which can be moved to suit the position of the job on the work table.

To exploit the precision afforded by the E.M.I. electronic control system, the machine tool must be specially rigid and accurate. While it is normal milling practice to clamp either the saddle or table during a cut, both must be free to slide under electronic control—a requirement which demands special accuracy of the slides to prevent vibration.

The machine illustrated has manual rise and fall to the knee, and has been modified with special leadscrews and nuts, both hardened and ground to very close limits, fitted to the saddle and table ; recirculating ball leadscrews are fitted with two sets of nuts backlash-loaded against each other. Hardened and ground precision gears are used in the servo motor drives to the saddle and table, and to their respective position-identifying analogue units, with a special backlash eliminating device in the gear trains transmitting power to the saddle and table, so ensuring accurate and consistent relative alignment of each machine movement. Lubrication to the spindle drive gears and bearings is from a standard spray system built into the column. In addition, the drive and position units and special leadscrews are lubricated by oil mist, a reliable air supply of 75 lb per square inch being required for this purpose. Full coolant facilities are provided. The longitudinal table movement and the transverse saddle movement are designed to position to within $\pm 0{\cdot}001$in of the true position as instructed by the tape when traversing in either direction. The special detachable 16in diameter rotary table has final drive through a precision worm and wheel. As the table will be programmed to rotate in one direction only, the standard backlash-eliminating device did not have to be modified for this application. The rotary table will position to within ± 2 minutes of arc of the true position as instructed by the tape.

The other illustration on this page shows the first industrial television equipment to be bought by the National Coal Board. It is installed, experimentally, as an aid to plant control at the Manvers coal preparation plant at Wath-on-Dearne, which processes the output of four collieries and is the largest of its kind in Great Britain.

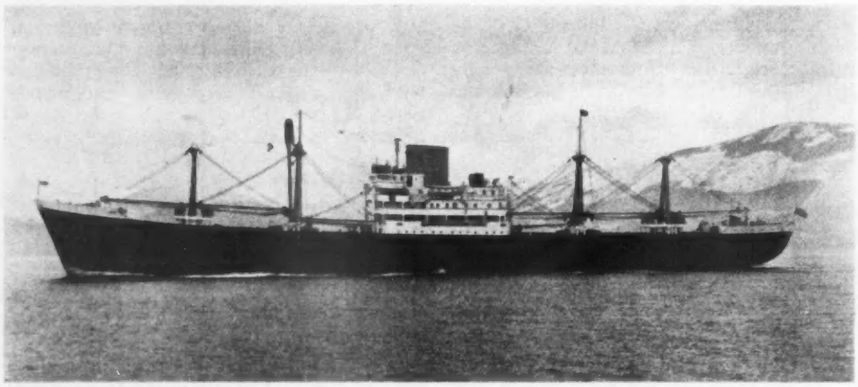
This closed circuit television installation, consisting of a Marconi industrial "Vidicon" camera, a control unit and a 14in monitor, is being used to observe the coal input conveyor system at a crossover point where several conveyor belts converge. On the monitor in the plant control room, illustrated here, the duty engineer can supervise belt working and loading conditions ; any fouling of the belt or failure of the drive is at once apparent and the duty engineer can take remedial action without delay.

Shipbuilding and Marine Engineering in 1957

No. II—(*Continued from page* 24, *January* 3)

EXPANSION of shipyards abroad has brought forward the suggestion that the number of berths should be increased in this country, but to do so would mean difficulty in manning at a time of full employment, and also a spreading out of the already inadequate steel supplies. Apart from the fact that this country already has many berths, some degree of caution is necessary, for shipbuilding may not always be so buoyant, so that investment in increased building facilities may in effect be buying redundancy in the future. However, more shipyards abroad do mean potentially stronger competition, therefore the British industry must plan to keep building costs down by making full use of material, machines and labour. With regard to the use of material perhaps a greater degree of standardisation, especially on tankers, might help, but both the latter factors are largely dependent upon the trades unions adopting a realistic attitude towards new techniques in ship construction. The demand for a forty-hour week does not appear to be in accord with present requirements of the industry, or to reveal any awareness of the need to maintain our competitive strength rather than run the risk of pricing ourselves out of the market. When all the working days lost through disputes, the hours wasted in discussions, and the time lost through clocking-in late and knocking-off early are considered shorter hours hardly seem to be the answer. Labour may demand a shorter working week and it may even be established through the recommendation of a court of inquiry, but in the final event the wages structure is supported by production, in contrast with the nationalised industries which have treasury support.

In 1957 the problems to be solved by shipowners continued to be taxation, high cost of replacement, flag discrimination, flags of convenience, subsidised air competition and the effects of internal inflation, all in the face of keen world competition. None were solved; the penal level of taxation remained although it is difficult to understand how that part of the profits set aside for new building cannot be relieved of taxation. Ships must be replaced after a fixed number of years and the rapid rise in cost is making it more and more difficult to find the necessary money out of taxed profits. The gravity of the situation is illustrated by our steadily decreasing share of the steadily increasing total of world tonnage. In this century our share has dropped from 50 per cent to 18 per cent. This position puts a premium on competitive ability and constitutes a threat to the considerable invisible exports, amounting to well over £200 million, earned by our shipping services which make a valuable contribution to the balance of payments. A further aggravation was the effect of flag discrimination, but of more importance was the fact that about 10 per cent of the worlds' tonnage was operating under tax-free flags of convenience. The increase in the investment allowance gave some measure of relief to shipowners, but was not a cure, and to combat the danger Viscount Simon, the President of the Chamber of Shipping, put forward the idea of forming a group of nations in which none would allow their ships to be registered in any country outside the group.



The cargo liner "Egori" has a length between perpendiculars of 465ft by 64ft beam by 36ft in depth, and was built and engined by Scotts' Shipbuilding and Engineering Company, Ltd., for Elder Dempster Lines, Ltd. A deadweight of 10,541 tons is carried on 27ft 9in draught, and there are six holds served by one 50-ton, eight 10-ton, ten 5-ton and two 3-ton derricks. Electric power is supplied by four 180kW diesel-driven generators and propulsion is by a Scott-Doxford turbo-charged oil engine having six cylinders of 670mm diameter by 2320mm combined stroke, and a rated output of 8000 b.h.p. at 116 r.p.m.

Shipowners, notably Sir Donald Anderson, while recognising that air transport was a valuable supplement to sea transport, could see no reason why state-owned air travel should be heavily subsidised with taxpayers' money, the taxpayers including the shipping companies. After all, the ship remains the cheapest form of transport and is absolutely essential to the economy of the country.

Research and Development

Towards the end of last year shipbuilding research was brought into public discussion when the Annual Report of the Advisory Council on Scientific Policy adversely compared the effort put forward by the industry with that of other countries and other major British industries. Reaction to the opinion expressed by the report was not slow, a forthright rebuttal of such criticism was made in a statement from Mr. J. A. Milne, the President of the Shipbuilding Conference. He wondered about the source of the information available to the council, since the shipbuilding industry was not approached, and deplored it making pronouncements before so doing. Mr. Milne drew attention to the industry's long record of scientific achievement and pointed out that it had two research organisations, namely, the British Shipbuilding Research Association and Pametrada, both founded in 1944, well in advance of other countries where similar organisations have been set up since. In addition to the work of B.S.R.A., individual firms undertake research and three have ship model testing tanks, while the volume of research is reflected in the transactions of the four principal technical societies. With regard to other British industries, Mr. Milne's statement recalled that each ship is tailor made, so that ship research is directed to improvement rather than the evolution of new designs, and also that Government contracts often financed research in many industries but not shipbuilding. To the volume of the industry's own efforts must be added the relevant sections of Admiralty research and also the work of Lloyd's Register of Shipping in order to make a correct assessment.

This statement by the Advisory Council was also the subject of some remarks by Viscount Simon, who said that, since conditions at sea could not be reproduced artificially, the basic investigation of ship and marine engine problems did not lend itself to pilot plant scale. Furthermore, he pointed out, many developments did not appear in the research account but were included in the cost of the ship and reflected in the maintenance charges. Referring to the question of the relative amounts spent on research, he thought that if the advances made by shipbuilding research have been achieved at less cost than that incurred by other industries, then the matter was one for congratulation.

The foregoing remarks are evidence of the general awareness of shipowners of the value of research and their response to new ideas. Under the leadership of Dr. S. L. Smith, the B.S.R.A. indicated that it was aware of the value of co-operation of the shipowners in matters of research: a development during the year, which bore witness to this, was the inauguration of a scheme whereby a new category of associate was instituted, to which British shipowners were to be admitted as members, an opportunity of which many owners have already availed themselves. The position, in brief, was that both shipbuilder and shipowner were fully cognisant of the significance of the leading part to be played by scientific research in the improvement in the design and performance of ships. Thus, it is recognised that technical advances in ship construction and marine engine building, allied with efficient ship operations, were essential in maintaining Britain's lead in maritime affairs.

During the year the question of nuclear propulsion has remained well in the forefront as a means of powering merchant ships. The Admiralty also has a vital interest in this matter and has set up a committee, under the chairmanship of the Civil Lord, Mr. Galbraith, to inquire into and assess possibilities. It is understood that, in addition to interested Government departments and the Atomic Energy Authority, both shipbuilders and shipowners will be represented, but at present the composition of the committee has not been announced. Nor has there been any public statement about its work by Mr. Galbraith, except in reply to a

question in the House of Commons, when he stated that a number of schemes were under immediate consideration but that no recommendation could be made at present, and that " It follows that no decision has been made in the building of the first ship."

As is well known, and was mentioned in this review last year, B.S.R.A. has a team at Harwell which is studying both the technical and economic problems of nuclear propulsion on behalf of the shipbuilding industry. Some of the results of the team's activities were given in a paper entitled " Nuclear Power for the Propulsion of Merchant Ships," which was presented by S. L. Smith, D.Sc. (Eng.), and J. E. Richards, B.Sc. (Eng.), Ph.D., on the occasion of the centenary meetings of the Institution of Engineers and Shipbuilders in Scotland. The paper, an abstract of which appeared in THE ENGINEER of July 12, emphasised the importance of the question of the safety of a marine installation, and also examined the economics of nuclear power as applied to a tanker of 47,000 tons deadweight. An extension of the study to include a 100,000 tons deadweight oil tanker did not reveal any great saving in transport costs. Unless natural uranium-fuelled reactors proved acceptable or enriched fuel was available at the right price, then the authors thought that the application of nuclear power to merchant ships was some years distant. However, it was realised that technical advances would reduce the cost of nuclear power, while power obtained from coal and oil would increase in cost.

Experimental work at both full scale and model size was continued throughout the year on several problems concerning ship structure, and this was paralleled by theoretical approaches. At the St. Albans tank of Vickers-Armstrongs, Ltd., tests were carried out with the object of determining the maximum bending moment set up by waves, which were created by the new wave maker recently installed in the tank, using an articulated model fitted with strain gauges. A description of the wave maker and a note about the model appeared in an article describing the tank, which was published in our issue of January 25, 1957. The test series consisted of running a model in the tank in waves which varied in both length and height.

A complementary programme of static bending tests has been carried out on actual ships, and supplementary to this there was put in operation, as opportunity offered, a programme for measuring the strains actually experienced by ships in service at sea. Considerable importance is attached to this work, for which autographic recording and statistical strain gauges, designed by B.S.R.A., were installed on a number of vessels. The results proved to be of considerable interest and two reports based on the work were issued during the year. The first gave information to assist in the practical calculation of ship bending moments, while the second dealt with the effect of wave form and length on bending moments.

At Glengarnock, both the testing machines were fully occupied, and, in co-operation with Lloyd's Register of Shipping, full scale tests designed to discover the best way to compensate efficiently for slots cut in underdeck girders were completed. Further work dealing with the question of compensation was related to the problem of trunk openings in girder webs, and a series of investigations were put in hand. Some of the work completed at Glengarnock was the subject of reports issued to members. One such report recorded the results of tests on panels of deck plating associated with heavy longitudinals, a second reported the results of tests comparing steel and light alloy hatchway beams, while the contents of another report consisted of a design note with reference to stiffened plating in compression. The foregoing are examples of the extremely practical work for which the machines at the Glengarnock establishment are used. Also forming part of the programme and put in hand towards the end of the year was a scheme to investigate the efficiency of swaged bulkhead construction subjected to normal and column loading. Work on items other than the main ship structure also occupied the attention of the staff, and investigations were made into the strength of cargo handling equipment.

The methodical series experiments on oceangoing merchant ship forms which have formed part of the work of the hydrodynamic section for a number of years was further advanced and a paper, which dealt with the experiments with 0·70 block coefficient forms, was presented at the spring meetings of the Institution of Naval Architects by R. E. Blackwell, B.Sc., G. J. Goodrich, B.Sc., and D. J. Doust, M.Sc. The purpose of the programme is to collect data sufficient to compile a chart from which naval architects will be able to obtain reliable values of resistance and the power required to drive a new hull form within a wide range of variables. Paralleling this programme is that relating to the B.S.R.A. parent trawler form upon which work was continued during the year. Due attention was paid to the importance of informing members of the resistance research being carried out abroad, and upon this matter two technical memoranda were issued. These gave a summary of the Norwegian systematic experiments using models of fast coasters and recorded the results of tests made in Sweden on models of ships having a block coefficient of 0·525.

In the climatic testing tank at Weybridge of Vickers-Armstrongs (Aircraft), Ltd., a research programme was completed dealing with the loss of stability in trawlers under icing conditions. In collaboration with the staff from the firm's St. Albans tank, the effect upon stability due to the formation of ice of varying amounts was measured with the trawler model placed in various attitudes to the wind. The results indicated that it was possible to cause the ice to form lower on the rigging and so reduce the adverse effect on stability of ice top hamper.

Included in the research programme was an item which was concerned with the provision of design and performance data relating to the effect of wind. A number of models were tested in the wind tunnel at the Aerodynamics Division of the N.P.L.

The association continued to collaborate with the Ship Division of the N.P.L. in the work on the correlation of ship and model results, and an important part of this work is hull surface roughness effect. As is the practice of the association, readings were taken at trials attended by the staff: it was noted that individual firms were also aware of the importance of hull roughness and also took readings. A gauge to measure roughness has been developed at the Palmers Hill laboratory and arrangements were made for this to be manufactured for the use of member firms. At the same time a technical memorandum was issued containing directions for the use of the gauge and the interpretation of the readings.

Among the trials attended were two which provided the opportunity to retest the ship after a period in service and so made it possible to compare the record of surface roughness obtained on the ship's acceptance trials with those measured after twelve months' service and before being dry docked, and again after dry docking.

Vibration problems continued to be the object of much theoretical and experimental work in order to amass data which will assist designers in attacking the problem. Some of the results were given in April in a paper entitled " Graphic Presentation of Hull Frequency Data and the Influence of Deck-Houses on Frequency Prediction " read by A. J. Johnson, Ph.D., and P. W. Ayling, B.Sc., before the North East Coast Institution of Engineers and Shipbuilders. Among the other research items upon which work was carried out during the year were the vibration of stiffened panels and of free-free beams, while an initial analysis of the data obtained from entrained water experiments indicated that experiment and theory were in fair agreement. In addition to the experimental work, troubles experienced in a number of vessels were investigated and the findings were issued in the form of reports.

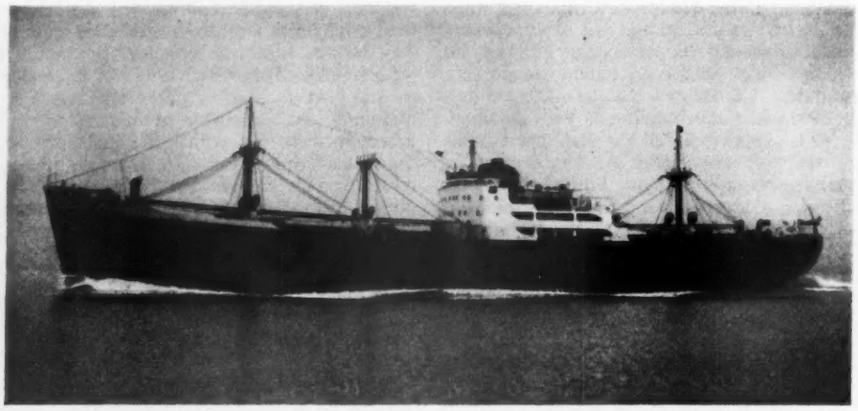
The four main sections of the ship machinery part of the research programme were ; steam, internal combustion engines, auxiliary plant, and materials. Brick and brick bolt materials were an important item in the first section, and work done by a special marine boiler refractory committee, on behalf of the association in conjunction with the British Ceramics Research Association, resulted in the production of a report upon combustion chamber linings for marine water-tube boilers. This report surveyed current experience in the construction and performance in service of monolithic linings.

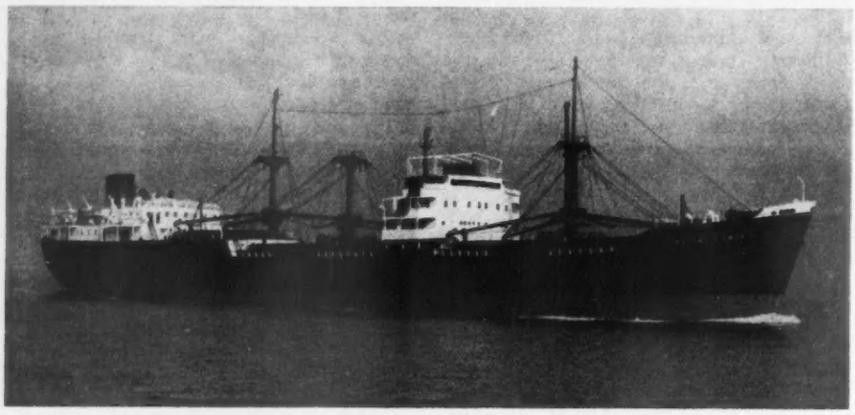
By the end of 1957 the final stages of investigations into the effect on the behaviour of funnel smoke of funnel height shape and efflux velocity, were well forward. It is hoped that the conclusions made will be of assistance to designers in keeping the decks free from smoke. An important section of the programme is investigation into noise problems. One particular item concerned work to determine the relative importance of airborne and structure noise, and members received a report which dealt with the transmission of noise from a gas-turbine-driven electric generator on board ship. During the year the association, together with the Royal College of Science and Technology, Glasgow, and the Mechanical Engineering Research Organisation were engaged in an investigation of the maximum bearing pressures and rubbing velocities permissible with mild steel shafts. To carry out this work the college designed and built a 3in bearing testing machine.

The two experimental single-cylinder, two-stroke opposed piston engines at the Barrow works of Vickers-Armstrongs, Ltd., continued to be used for scavenging research and a report was prepared on the subject of scavenging and charging of two-stroke, opposed piston marine oil engines. With regard to crankcase explosions it was noted in last year's review that an oil mist detector had been developed in collaboration with the Graviner Manufacturing Company, Ltd. This mist detecting apparatus is now in production, and besides having been installed in a number of ships has been undergoing prolonged trials at the works of Ruston and Hornsby, Ltd. One of the items concerned with the auxiliary plant section of the programme upon which work was commenced, was the question of the natural ventilation of cargo spaces. The work, as planned in conjunction with the Refrigerated Cargo Research Council, included shipboard and

Cargo Ships

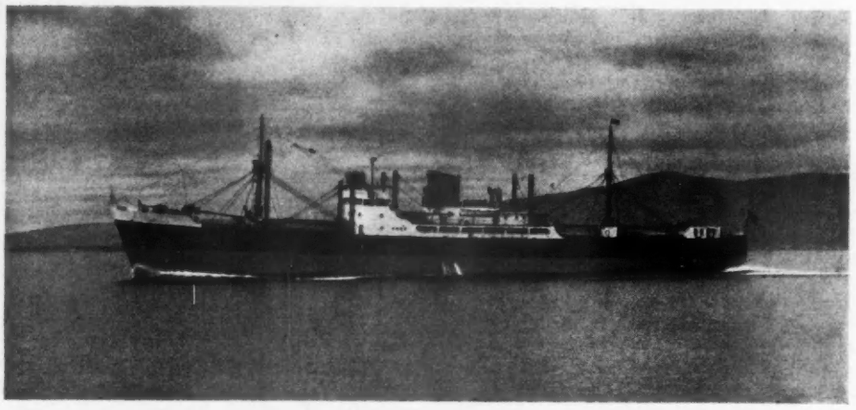
The "Huntsville" was built by the Burntisland Shipbuilding Company, Ltd., for the Power Steamship Company, Ltd., and the main particulars are: length between perpendiculars, 450ft 3in; breadth, 63ft 10½in; depth, 40ft 5in; deadweight, 12,160 tons, and draught, 27ft 10½in. There are five holds and the cargo is handled by six 5-ton and four 10-ton derricks. Propulsion is by a Hawthorn-Doxford opposed-piston oil engine, six cylinders, 670mm diameter by 2320mm combined stroke, 6600 b.h.p. at 115 r.p.m., and three 320kW diesel-driven generators provide the electrical power

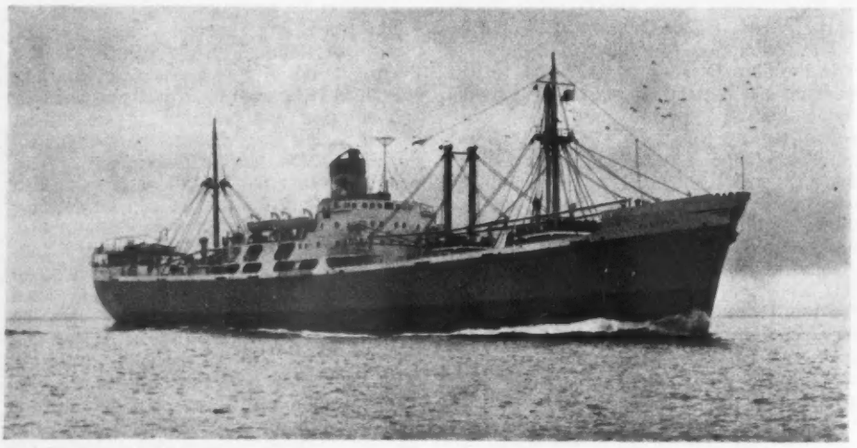




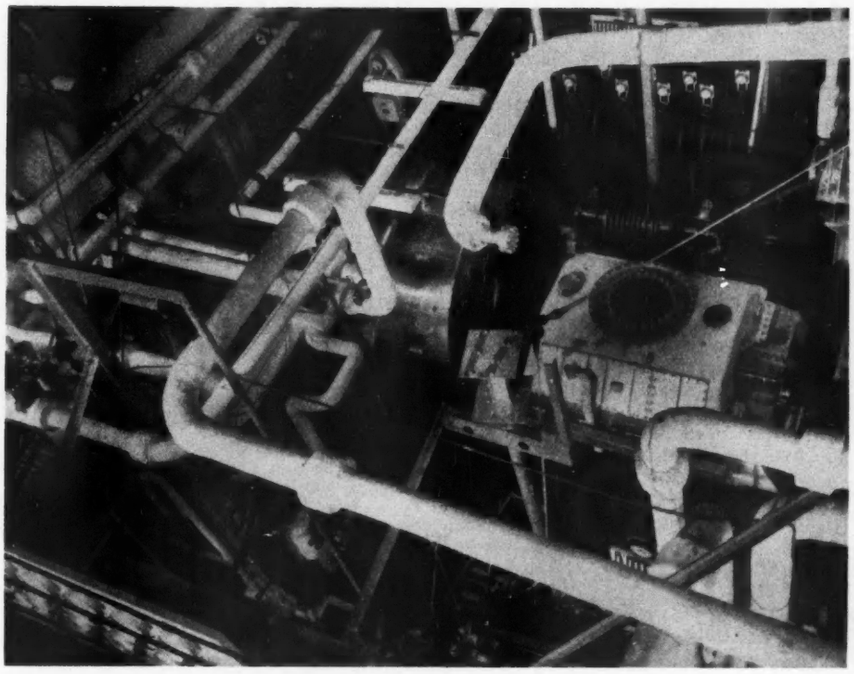
Hawthorn Leslie (Shipbuilders), Ltd., completed the cargo ship "Crystal Diamond" to the order of the Sugar Line, Ltd., and the ship carries a deadweight of 9780 tons on the following dimensions:—Length between perpendiculars, 430ft; breadth, 61ft; depth, 37ft 3in, and draught, 24ft 6¾in. Wing spaces are arranged abreast four of the five holds, which are designed to carry bulk cargoes such as sugar, grain or iron ore for loading or discharging by grabs, and there are one 25-ton and ten 10-ton derricks. Two 75kW diesel-driven generators and one 20kW steam-driven generator are fitted and a service speed of 12 knots is maintained by a four-cylinder Hawthorn-Doxford oil engine developing 3300 b.h.p. at 108 r.p.m. A sister ship, "Crystal Crown," was built by Smith's Dock Company, Ltd.

The cargo liner "Thessaly" was completed at the Govan yard of Harland and Wolff, Ltd., for the Royal Mail Lines, Ltd., and the ship has a length between perpendiculars of 415ft by 58ft 6in beam by 38ft 4in in depth, with a gross tonnage of 7300. The five cargo holds are served by one 30-ton and fourteen 10-ton derricks. Propulsion is by a Harland and Wolff two-stroke, single-acting, opposed-piston diesel engine, having six cylinders of 620mm diameter by 1870mm combined stroke. Electrical power is supplied by three 150kW diesel-driven generators. The builders also completed two sister ships, the "Albany," at Govan, and the "Picardy," at Belfast





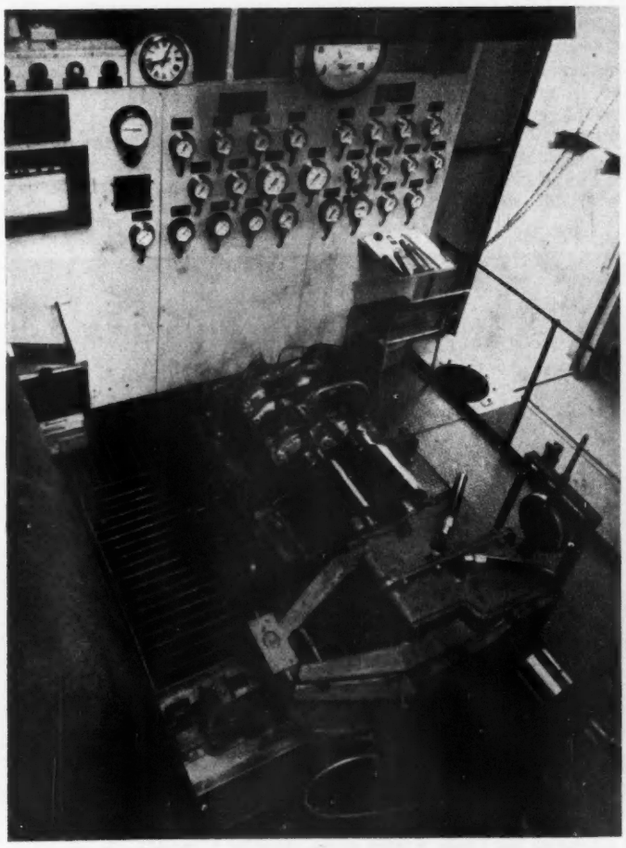
William Denny and Brothers, Ltd., completed the closed shelter deck cargo liner "Valetta" for Mr. O. Ditley-Simonsen, Jr., of Oslo, and the ship has five cargo holds and two complete decks, and carries a deadweight of 12,100 tons on a loaded draught of 28ft 6in and a length overall of 493ft by 63ft beam by 40ft 3in in depth. The cargo handling gear consists of one 25-ton, two 10-ton and ten 5-ton derricks, operated by electric winches, and four 3-ton electric cranes. Electric power is provided by three 180kW generators, and the necessary power to maintain a service speed of 14 knots is developed by a set of single-reduction geared turbines supplied with steam at 450 lb per square inch and 750 deg. Fah. by two Foster-Wheeler boilers



General arrangement of Y.E.A.D. 1 machinery

model tests designed to determine the best position for ventilators and the relative performance efficiency of various designs of ventilator cowls. The mechanism of failure of internal combustion engine components exposed to combustion conditions formed one of the investigations put in hand in the material section. Nottingham University was responsible for the work and for the report issued upon the thermal and elastic properties of eight cast irons.

The Imperial College, London, co-operated in the work upon the expanding of boiler tubes, and a paper which dealt with the process of expanding boiler tubes was prepared by Professor J. M. Alexander and H. Ford and presented before the Institution of Mechanical Engineers at the beginning of the year. A report was also issued upon the effects of re-tubing, starting position of the cage in the joint and tack rolling. The long term investigation into the corrosion of mild steel tubes was continued by the corrosion group at the Chemical Research Laboratory, Teddington. A two part paper based on the work and entitled "Corrosion in Scotch Marine Boilers" was given in February before the Institute of Marine Engineers. Part I "Model Boiler Tests on the Corrosion of Mild Steel Tubes in Highly Saline Waters" was presented by F. Wormwell, D.Sc., Ph.D., G. Butler, M.A., Ph.D., and J. G. Beynon, while the author of Part II "Model Boiler Tests on the Influence of the Copper Content of the Steel on the Corrosion of Tubes in Artificial Sea Water," were G. Butler, M.A., Ph.D., and H. C. K. Ison. The work stimulated further research and a scheme was put in hand with the object of discovering whether an increase in the copper content of the steel will reduce the depth of pitting in electrical resistance welded tubes in sea water. A research item dealing with the materials for superheater tubes and supports was completed.



New high-speed 10in centres gear rig

Fatigue strength of engine shafts, shaft couplings and crankshafts was the principal object of the research carried out at the Crawley laboratory of Lloyd's Register of Shipping. A report was issued which had as its subject the effect of fillet radii on the torsional fatigue strength of marine shafting and included some proposed empirical formulae for extrapolation of the results. A final item of the machinery section of the research programme, upon which a report was issued, was the production and fitting of propeller shaft liners, bushes and bearings, coupled with a survey of current practice in design and assembly.

It has only been possible to outline some of the items, numbering nearly ninety, which make up the association's research programme. However, they should answer the criticism that the marine industries are not research minded—and the answer provided by the activities of the British Shipbuilding Research Association is reinforced when the work of Pametrada is also considered.

Member firms received a total of thirteen research reports, while eleven contract reports were forwarded to the Admiralty, according to the latest information published by the Parsons and Marine Engineering Turbine Research and Development Association.

During the period reviewed by the report the steam turbine design section dealt with sixty-two inquiries, about half of which were for powers higher than 15,000 s.h.p. per shaft, and attended twenty-one acceptance trials. A further twelve tankers were completed, having 7500 s.h.p. installations, so that the total with this class of machinery now numbered forty-one, while five 13,000 s.h.p. tanker installations, using steam at 560 lb per square inch gauge and 840 deg. Fah., were in service.

Theoretical investigation of disc vibration characteristics made considerable progress, a point which was of particular interest when consideration is being given to the use of higher blade speeds for l.p. turbines, due to the demand for an increase in unit power. A research scheme was initiated to correlate this work with practical tests. The gearing design section was concerned with work on conventional, hardened and ground reduction gear units, including the Pametrada reversible hydraulic transmission line. Points concerning the reversing unit for the "Auris" conversion unit were settled and, in particular, problems related to flow conditions in couplings, friction clutches and converters and questions pertaining to friction materials were solved. Development of an automatic clutch suitable for cruising turbine operation was in hand; the first part of the work included assessment of the forces obtaining.

Work was completed on the prototype profile-generating grinding head for the 30/90in gear grinding machine building at Craven Brothers (Manchester), Ltd., and a test programme, involving a running time of 500 hours, was drawn up.

In the gas turbine design section inquiries for a reversing turbine of 4000 s.h.p. and another of 1000 s.h.p., both to operate with free piston gas generators, were dealt with. Both designs had five impulse ahead stages and a two-row Curtis astern wheel. There was also an inquiry for a set of gas turbine machinery to develop 3000 s.h.p. and incorporate fluid reversing transmission. A double compound design with intercooling, reheat and heat exchange, with a maximum

temperature of 1250 deg. Fah. and an overall pressure ratio of 12 to 1, was proposed. A design study of a 10,000 s.h.p. installation having a temperature of 2200 deg. Fah., a pressure ratio of 16 to 1, and an estimated fuel consumption of 0·35 lb per shaft horsepower per hour was completed. For the single-stage, high-temperature gas turbine, a new design of rotor assembly was prepared to allow axial withdrawal of the rotor, and water lubricated bearings were adopted.

A promising design was evolved of a pressurised combustion boiler and a start was made on working out the details. Possible feed cycles for inquiries which range from 5000 to 60,000 s.h.p. have been a subject of investigation particularly to find the best cycle for a unit of 12,000 s.h.p., using steam at 950 deg. Fah. Voyage data from a number of ships was analysed in order to assess how close running conditions were to design conditions. Progress was made on a report concerning methods of driving auxiliary machinery and the use of regenerative heating.

Further full-scale trials were carried out on the Admiralty Y.E.A.D. 1 installation, of which we reproduce a photograph showing the general arrangement, and further tests were carried out on the double casing h.p. turbine of 4000 b.h.p. A theoretical analysis of the effect of resilient mountings on the critical speed of rotors was completed. A method of accurately determining gland clearances was evolved, making use of small wax wedges of known taper. Among the research items on gas turbine components was work on ash fouling and corrosion of cooled specimens of heat-resisting alloys, and a report was issued on the evaluation of the resistance of high temperature alloys to vanadium ash corrosion. A report was issued covering the first set of Pametrada gear trials and trials of a second set of gears were carried out. A 200-hour run at 10,000 r.p.m. was made during the 10in centres gear trials ; our illustration shows the new high-speed rig. An improved design of " A " bracket bearing was completed and tested and bearings were made for trials at sea, while a report was prepared on bolt seizing tests and a further programme decided upon.

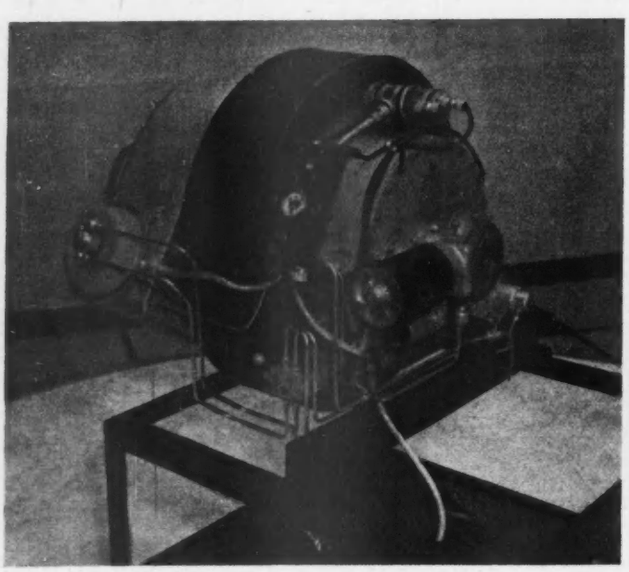
(To be concluded)

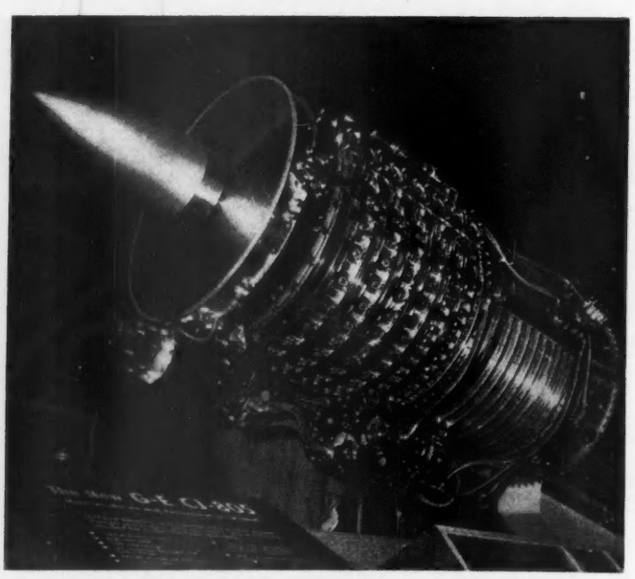
Gas Turbines in 1957

IN this country the last year was remarkable for the emergence of a number of centrifugal engines. This development, notably divergent from the recent policy of the National Gas Turbine Establishment, is probably to be attributed to the growing awareness of the cost and time involved in developing an acceptable axial compressor from scratch. The three original designs illustrating this trend were the 250 h.p. engine of the Standard Motor Company, with a radial inflow turbine, the 430 h.p. engine of Ruston and Hornsby, with three-stage turbine, and the Armstrong Siddeley designs for an aero engine of about 1000 h.p. Both the industrial units are, of course, of low efficiency—12 per cent for the larger engine—and their advantages are rather compactness to fit in a ship's engine-room or lightness to allow transportation to an oil-field. The Armstrong Siddeley "P.181" and "P.182" are free turbine engines; the complication of co-axial shafts has been rejected, as in other small engines such as the General Electric "T-58" (a remarkable unit giving 1050 h.p. from a 250 lb machine), and in the "P.182," a propeller-driving plant, the intakes and exhaust will, in tractor installations, be in the opposite position to that familiar now. These latter engines are as yet in the design stages, only mock-ups having been built ; since the mock-ups were displayed at Farnborough, the appearance of the design has, we understand, altered considerably, so that it is not possible to illustrate either engine.

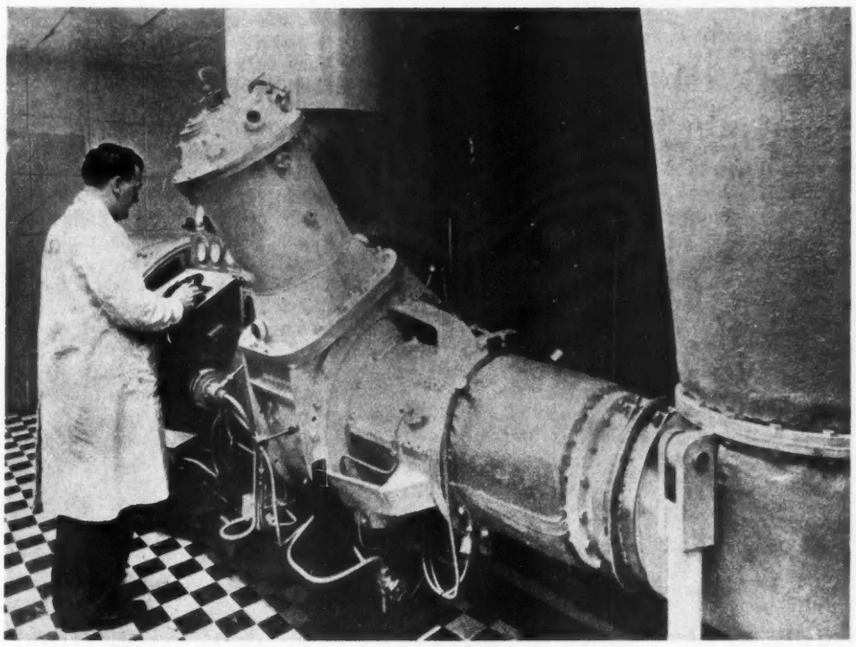
The trend in high-performance engines has been quite distinctly towards more complicated compressors, in order to avoid matching problems without loss of efficiency. The compound engine, invariably straight-coupled, has established itself for aviation, being in R.A.F. service with the Avro " Vulcan." In the United States of America it is even more emphatically endorsed, practically every supersonic military aircraft in that country having a two-spool engine, while all the large jet airliners at present on order will have such engines, in some cases Rolls-Royce " Conway " by-pass engines. The relation between pure and by-pass jets has been the subject of many studies, two or three of which have been reported in THE ENGINEER, and it appears that the expected low weight of the by-pass, together with the merits of the individual design, will secure a place for the " Conway " even in long-range operation, despite the penalties of higher specific consumption and turbine inlet temperature exacted by the cycle.

The exceptions among the supersonic military aircraft mentioned above have the General Electric " J-79 " engine; indeed, it is reported that one of them, the Grumman " Tiger," has exceeded both the altitude and the speed at present recognised as records. The " J.79 " has a seventeen-stage compressor, in which the first six sets of stator blades, as well as the inlet guide vanes, have variable incidence. As our illustration of the civil version, the " CJ-805," shows, the control gear for incidence changes is simple, all six rows being coupled together. In airline operation—the engine is specified for a medium-range jet, the Convair " 880 "—the blades go to one extreme of their travel as the take-off run is commenced and remain there until the aircraft reaches the tropopause during let-down. The blades change incidence gradually with increasing ambient temperature during both descent and approach, but the other extreme incidence is reached only in ground idle. It is clear that this represents a relatively elementary use of incidence control, invoked principally to avoid surge at intermediate mass flows, and that it might be possible in future to make more ambitious applications of the principle. As it is, by allowing the use of a single-spool construction, the elaborate compressor has yielded an engine of light weight—2690 lb for 10,500 lb static thrust—and the makers have felt able to guarantee the maximum maintenance costs over two years' use for both the " CJ-805-1 " and the " CJ-805-3 " ;

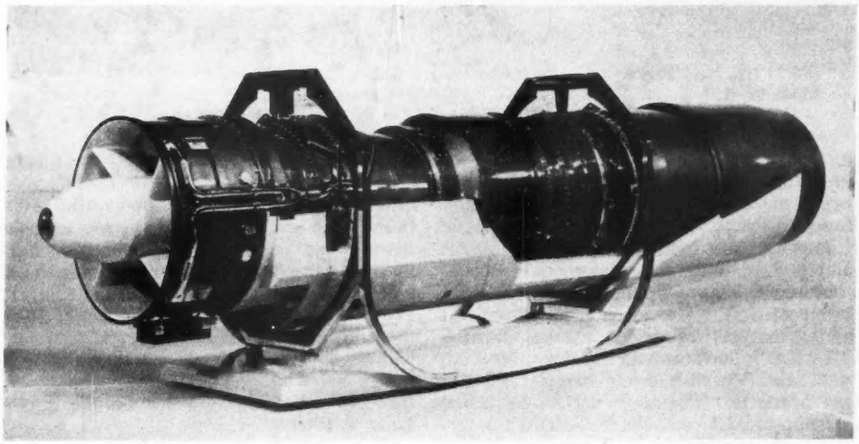




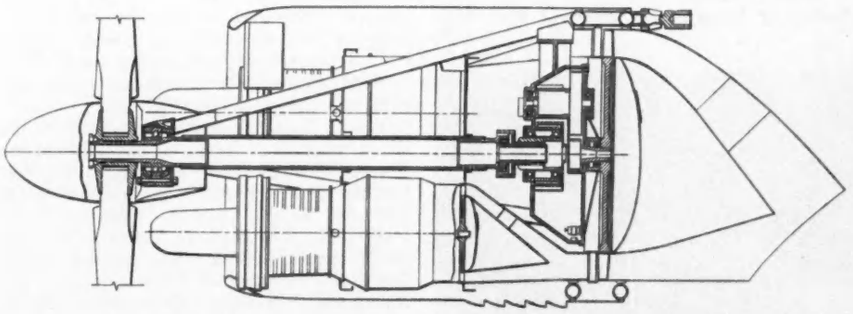
(Left)—The Standard "1S/250" has radial-flow turbine and compressor; the Dowty spill-burner fuel system is fitted to this example. (Right)—Compressor of the General Electric "CJ-805," civil version of an engine used only in military aircraft for supersonic performance, showing the split compressor casing and the linkage for varying the incidence of the first six stages of stator blades. The inlet guide vanes move with the stators, but are separately adjustable



The Ruston " TE " engine, with a centrifugal compressor and a three-stage turbine, gives 430 h.p. and runs at 19,250 r.p.m.



The Orenda " Iroquois " with Marquardt after-burner. A pair of these large two-spool engines will power the Avro " Arrow " Mk. II



The " turbobarillet " uses a number of jet engines to form a turbo-prop engine

the latter, with speed and temperature increased for take-off, is naturally reputed to be more expensive to maintain. Variable stator blades are also used in the above-mentioned " T-58." A somewhat surprising feature of such an advanced engine as the " CJ-805 " is the use of twelve flame tubes within the annular combustion rather than a true annular chamber.

The supreme example of the contemporary supersonic two-spool turbine was unveiled during last year, the Orenda " Iroquois " ; this is reputed to deliver up to 30,000 lb thrust, with reheat, and weighs rather less than 6000 lb.

The year has been important for distinct gains in the knowledge of the relationship of gas turbines to their environment. The Bristol " Proteus " engine has, as recorded in the corresponding article last year, shown itself sensitive to certain forms of water in the atmosphere, the response taking the form of flame-out of some or all combustion chambers. To reproduce these conditions on the test bed, it was found that concentrations of water ten times higher than those normally accepted were necessary. Some experience in regular operation through the tropics has also been acquired by the Rolls-Royce " Avon " ; however, it appears that relatively little information has been derived from the operation of the " Comet " by the R.A.F., even as formerly by B.O.A.C.

Various proposals have been made, particularly in connection with vertical take-off and landing projects, to use a number of jet engines to drive a large fan or similar device. An unusually detailed study of a related idea is included in the scheme of M. de Valroger for a " Turbobarillet," although the principal object of this project is to obtain a very powerful turbo-prop engine quickly and without a proportionately long and costly development programme ; when we compare the Soviet " Type K " engine of 12,000 s.h.p. with the products of other European countries, it is not difficult to see the attraction of the idea—one of the engines proposed would give 36,000 h.p., using four Atar jets. The proposal is to take three, or more, turbo-jet engines and duct the exhausts into one large turbine, geared to a propeller shaft ; our illustration shows an engine composed of three Armstrong Siddeley " Viper " gas generators, which would weigh 1415 lb as an engine alone, or 1785 lb installed, and give 6750 h.p. (the power is derived from the thrust rating as a jet engine by assuming efficiencies for the propelling nozzle and for the turbine—i.e. the speeds, pressures and temperatures in the gas generators remain unchanged). Such an engine could, clearly, make far better use of reheat than an after-burning turbo-jet. The concept is exploited so far as to specify a fixed pitch propeller, since, of course, feathering will never be required, though this is probably because the initial applications envisaged are on existing large aircraft of relatively low speeds. The principal disadvantage seen by the author is the high power consumption in windmilling any gas generator shut down, which is estimated at 20 to 30 per cent of its power output. However, the effect upon the power turbine blades of encountering hot gas in two-thirds of the nozzles and cooled air in the remaining third might prove so severe as to demand that the incidence of the inlet guide vanes could be increased so far as to shut off the flow entirely. It is also realised that a relatively poor fuel consumption will be encountered, but this may, to a certain extent, be discounted by the reduced initial and maintenance costs of an engine using numerous existing components.

At the other extreme of the gas turbine spectrum, the power station and marine propulsion application, progress has continued to be slow. The struggle to burn residual fuel oil continues, the emphasis remaining upon chemical additives for the fuel. One remarkably simple and attractive idea that has been mooted, initially in the United States, uses a closed cycle gas turbine to cool the gas, probably carbon dioxide, heated in a nuclear reactor ; the greater proportion of the heat must be dumped, of course, but in a marine application this need not be a strong objection. However, it would appear that the power available would depend rather heavily upon the sea temperature, and the cycle might be confined to, say, North Atlantic liners.

Naval Construction in 1957

By RAYMOND V. B. BLACKMAN

No. II—(*Concluded from page* 30, *January* 3)

United States

THE world's first atomic-powered aircraft carrier was ordered on August 16, 1957, from the Newport News Shipbuilding and Dry Dock Company, Newport News, Virginia, and the Westinghouse Electric Corporation of Pittsburgh obtained the contract to design and supply the reactor compartment components and build the steam propulsion machinery. Known at present as the "CVAN 65" (names being considered include "Congress," "Constitution" and "Enterprise"), this attack aircraft carrier will have a displacement of 85,000 tons, with an overall length of 1088ft, a hull beam of 133ft and an extreme width over the flight deck of 250ft. She will have a block island superstructure, no funnels, a fully angled deck, and four deck edge lifts, three on the starboard side and one on the port, all shaped to the folded form of the largest aircraft. She will carry guided missiles in batteries in each quadrant. Her propelling machinery will comprise eight pressurised water nuclear reactors and geared steam turbines designed for a maximum speed of 35 knots.

The U.S.S. "Ranger" (illustrated below), the world's largest carrier, was completed on August 10, 1957. Built by the Newport News Shipbuilding and Dry Dock Company, and engined by The General Electric Company, she has a displacement of 60,000 tons standard and 76,000 tons full load with an overall length of 1046ft, a waterline beam of 129½ft and an extreme width of 252ft. She is armed with eight 5in dual purpose guns and is provided with guided missiles. Designed to carry ninety to 100 aircraft, according to size and type, her construction incorporates several British inventions, including a fully angled deck, mirror sight deck landing aids and the new steam catapults, of which she has four. Her main propelling machinery comprises eight Babcock and Wilcox boilers and four sets of cross-compound turbines and four double reduction gears turning four screws and developing 260,000 s.h.p., equal to a speed of 35 knots. A sister ship, the "Independence," was launched at the New York Naval Shipyard on October 10, 1957, when another ship of the class, the "Constellation" was laid down immediately in her place. Another sister ship, the "Kitty Hawk," was in an advanced stage of construction at the end of the year.

The U.S.S. "Long Beach," the first cruiser designed for the United States since the end of the second world war, the first guided missile cruiser built as such from the keel up and the first nuclear powered surface warship, was laid down on December 2, 1957, at the Quincy yard of the Bethlehem Steel Company, Massachusetts, the engineers being the Westinghouse Electric Company (nuclear reactors) and The General Electric Company, West Lynn, Mass. (steam turbines and gears). With a displacement of 14,000 tons she will have a length of 700ft and a beam of 75ft. Her armament will consist almost entirely of guided missiles, with a "Terrier" surface-to-air battery forward, a "Talos" surface-to-air battery aft, and the Mark II "Regulus" surface-to-surface weapon amidships. Her two-shaft arrangement of geared turbines is expected to give her a speed of 33 knots. The most modern improvements in electronic detection devices will be installed in her.

Seven guided missile ships of the destroyer leader or large frigate category were also in hand. With a displacement of 4770 tons, a length of 512½ft overall and a beam of 52½ ft, They will be armed with a conventional battery of two 5in dual purpose guns forward and a twin "Terrier" guided missile launcher aft, and four fixed 21in torpedo tubes amidships. Four boilers and a two-shaft arrangement of geared turbines developing 80,000 s.h.p. will give them a speed of 34 knots. Eight new guided weapon destroyers being built will be hardly less formidable. With a standard displacement of 3370 tons, an overall length of 431ft and a beam of 47ft, they will also mount the 5in rapid fire gun forward, but aft they will carry the "Tartar" guided missile installation, smaller but with greater range. A similar propulsion plant will give them a speed of 35 knots.

The U.S.S. "Seawolf" (shown here), the second atomic powered submarine, was finally completed on March 30, 1957. With a displacement of 3260 tons, a length of 330ft overall and a beam of 30ft, she has nuclear reactors and geared turbines of 15,000 s.h.p. to give a speed of 23 knots. She was built by the Electric Boat Division of the General Dynamics Corporation, Groton, Conn. Ten more atomic powered attack submarines, will have hulls of improved "tear-drop" design based on the shape of a whale with the conning tower modelled on the dorsal fin of a fish.

Nuclear-powered submarine "Seawolf." In the background is "Nautilus"

The "Halibut," in hand at the Mare Island Naval Shipyard, will be the first guided missile nuclear powered submarine and the first ever designed from the keel up as a guided missile carrier. With a displacement of 2900 tons, a length of 346ft and a beam of 29ft, she will have a water-cooled reactor and will be fitted to fire "Regulus" guided missiles. Three similar vessels are projected.

The "Triton," under construction by the Electric Boat Division and engined by The General Electric Company, is the first nuclear powered radar picket submarine and the largest military submarine ever attempted. Designed to keep up with the fastest aircraft carriers and destroyers, she has a displacement of 5450 tons light and a length of over 400ft. Two nuclear reactors and a two shaft arrangement of turbines will give her a speed of over 30 knots.

U.S.S. "Ranger." New giant attack aircraft carrier

Russia

Seven large cruisers of the improved "Sverdlov" class were under construction. With a displacement of 15,450 tons standard and 19,200 tons full load they have an overall length of 689ft and a beam of 70ft. Their armament comprises twelve 6in guns, twelve 4in guns, thirty-two 37mm anti-aircraft guns, ten 21in torpedo tubes, and 240 mines. Their propelling machinery con-

sists of six boilers and geared turbines of 130,000 s.h.p. equal to a speed of 34·5 knots. The later units are reported to be nearing completion with an advanced armament including guided missiles.

Ten of a class of twenty very large destroyers (shown below) were completed. Known as the "Kotlin" class, they are flush-decked with a displacement of 2850 tons standard and 3885 tons full load, an overall length of 425ft and a beam of 41½ft. Their armament comprises four 4in dual purpose guns, sixteen 57mm anti-aircraft guns, ten 21in torpedo tubes, and six side-thrown depth bomb projectors mounted on rotating platforms on the stern. They also carry eighty mines. A two shaft arrangement of geared turbines aggregating 90,000 s.h.p. gives them a speed of 38 knots.

"Kotlin" class giant destroyer

No fewer than seventy-five submarines were completed or launched by the end of the year. These were mainly of three types. The large ocean-going "Z" class, with a displacement of 2250 tons surface and 2700 tons submerged, have a length of 310ft and a beam of 28ft. Their armament consists of eight 21in torpedo tubes, two 57mm guns, two 25mm anti-aircraft guns, and forty mines. Diesel electric machinery gives them a speed of 22 knots on the surface and 16 knots submerged. The seagoing patrol "W" class have a displacement of 1300 tons surface and 1500 tons submerged, with a length of 245ft overall and a beam of 24ft. They have a similar torpedo and mine armament and some have a 3·9in gun in a retractable turret and a light anti-aircraft gun. Diesels and electric motors give them a speed of 17 knots on the surface and 16 knots submerged. The medium range "Q" class have a surface displacement of 750 tons with an overall length of 180ft and a beam of 21ft. They carry six 21in torpedo tubes and a twin 20mm gunhouse at a surface speed of 18 knots.

Several more of the flush-decked destroyer escorts of the "Kola" class were completed. With a displacement of 1250 tons standard and 1500 tons full load, they have an overall length of 305ft and a beam of 32¾ft. They are armed with four 3·9in guns, two 37mm anti-aircraft guns, three 21in torpedo tubes, and anti-submarine weapons. Their propelling machinery of 30,000 s.h.p. gives them a speed of 30 knots.

France

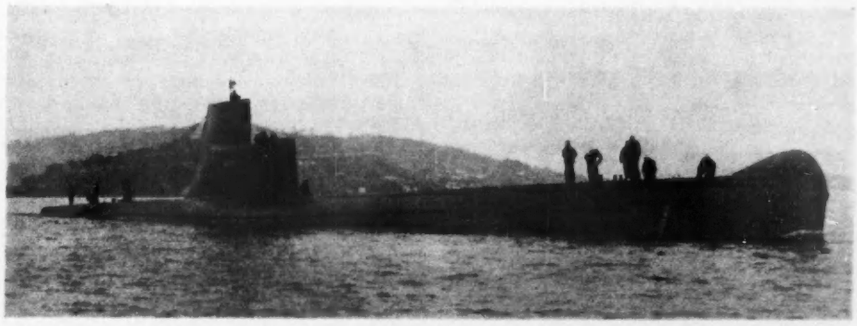
The second of the new aircraft carriers, the "Foch," was laid down at the Chantiers de l'Atlantique (Penhöet-Loire) in February, 1957. She and her sister ship, the "Clemenceau," launched on December 21, 1957 at Brest Dockyard, are designed for a displacement of 22,000 tons standard and 27,307 tons full load, with an overall length of 845ft, a hull beam of 96ft and an extreme width of 151ft. They will be armed with twelve 3·9in guns and a battery of 30mm anti-aircraft guns, and will carry sixty aircraft. They will have an 8 deg. angled deck, 543ft long and 96¾ft wide, two steam catapults and two lifts. Their propelling plant consists of six boilers and geared turbines of 126,000 s.h.p., turning two screws at a speed of 32 knots. A third new aircraft carrier, the largest ever built in France, will have a displacement of 30,000 tons. A new helicopter carrier, with a displacement of 10,000 tons standard, was laid down at Brest Dockyard in 1957.

The new anti-aircraft cruiser "Colbert" was on trials at the end of the year. Built by Brest Dockyard, she has a displacement of 8500 tons standard and 11,000 tons full load. Her armament comprises sixteen 5in guns and twenty 57mm anti-aircraft guns. Four multi-tubular boilers and geared turbines of 86,000 s.h.p., turning two screws, give her a speed of 32 knots. She will carry a helicopter. A new guided missile light cruiser is projected.

The prototype anti-submarine destroyer "La Galissonnière," laid down at Lorient Dockyard in 1957, represents the latest development of the "Surcouf" group.

Of the new "Le Normand" class destroyer escorts, six were completed. Displacing 1295 tons standard and 1700 tons full load, they carry six 2·25in guns, two 20mm anti-aircraft guns, twelve homing torpedo tubes, two anti-submarine mortars and a hedgehog at a speed of 27 knots obtained from two boilers and geared turbines of 20,000 s.h.p.

Four new submarines, "Dauphin" (shown here), "Marsouin," "Narval" and "Requin," were completed. With a displacement of 1430 tons they are armed with eight torpedo tubes and have a speed of 16 knots on the surface and 18 knots submerged. Two more of this class, the "Espadon" and "Morse," were under construction. Six submarines of 850 tons and four of 529 tons were also being built.



"Dauphin," latest French submarine

Italy

Two large destroyers, the "Impetuoso" and "Indomito," were completed. With a displacement of 2775 tons standard and 3592 tons full load, they have a length of 405ft and a beam of 42¾ft. Their armament comprises four 5in guns, sixteen 40mm anti-aircraft guns, four 21in torpedo tubes, and a triple depth charge mortar. Four Foster Wheeler boilers and geared turbines of 60,000 s.h.p. give them a speed of 34 knots.

Four light destroyers were also completed.

Netherlands

Four large anti-submarine destroyers were completed. They have no torpedo tubes like orthodox destroyers, and they are also unusual in having side armour and deck protection like light cruisers. With a displacement of 2476 tons standard and 3070 tons full load, they have a length of 380½ft and a beam of 38½ft. They are armed with four 4·7in guns, six 40mm guns, and two four-barrelled anti-submarine rocket throwers. The propulsion plant comprises geared turbines of 60,000 s.h.p., equal to a speed of 36 knots.

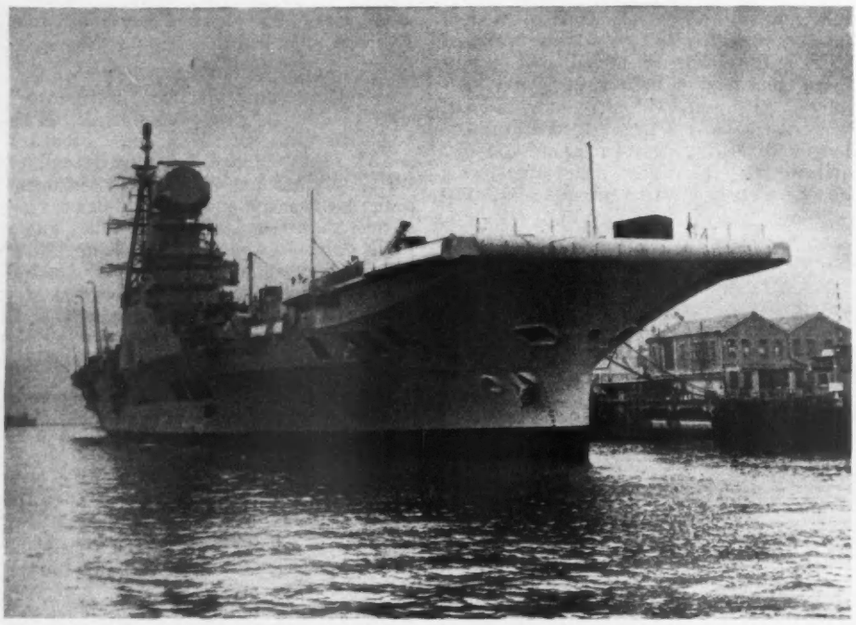
Sweden

Of four new destroyers, the "Hälsingland" was launched on January 14, 1957, and three others were nearing completion at the end of the year. Of 2050 tons standard displacement and 2600 tons full load, with a length of 380ft overall and a beam of 36¾ft, they carry four 4·7in guns, seven 40mm guns, six 21in torpedo tubes, a triple-barrelled depth charge mortar and sixty mines at a speed of 35 knots, obtained from two boilers and De Laval turbines of 40,000 s.h.p.

Two considerably larger destroyers under construction, the "Lappland" and "Värmland," are being equipped with a guided missile ramp and a helicopter platform in addition to the formidable armament of four 4·7in guns, two 2·25in guns, six 40mm anti-aircraft guns, eight 21in torpedo tubes, and two four-barrelled depth bomb mortars. With a displacement of 2730 tons standard and 3300 tons full load, a length of 397ft overall and a beam of 41ft, they have Penhöet boilers and De Laval double reduction geared turbines of 55,000 s.h.p., designed for a speed of 35 knots.

Japan

Four new destroyers were launched. They have a displacement of 1800 tons standard and 2500 tons full load, with a length of 358ft and a beam of 35ft. They are armed with six 3in guns, four 21in torpedo tubes, two hedgehogs and two "Y" mortars. Two Mitsubishi-Nagasaki boilers and two sets of Mitsubishi-Escher Weiss geared turbines of 35,000 s.h.p. develop 32 knots.



Aircraft carrier H.M.S. "Victorious," as reconstructed

Aircraft Carrier H.M.S. "Victorious"

ON January 14, H.M.S. "Victorious," shown in our illustration, will be commissioned, with Captain C. P. Coke, D.S.O., R.N., in command, and so will rejoin the Fleet after spending about seven years in the control of Portsmouth Dockyard. During this period, which commenced in October, 1950, when the ship was taken in hand for modernisation, many revolutionary developments have taken place and it has been the dockyard's task to incorporate these in the scheme of reconstruction. Although the new devices have no doubt occasioned numerous delays, so that the work has occupied a large number of years, the result has been to add to the Navy list a ship which may be described as the most modern of aircraft carriers. Among the improvements are included the several British developed aids to naval flying, such as the fully angled flight deck, the steam catapult and the mirror deck landing system. Reference to this major conversion scheme has been made already in an article entitled "Naval Construction in 1957," by Raymond V. B. Blackman, which appeared in our issue of January 3.

It will be recalled that H.M.S. "Victorious" which was completed in 1941, was built at the Walker Naval Yard of Vickers-Armstrongs, Ltd., and engined by the Wallsend Slipway and Engineering Company, Ltd. The following are the main particulars as published by *Jane's Fighting Ships*: length between perpendiculars 740ft, beam 95ft, draught 24ft, and armament of sixteen 4·5in guns, in twin mountings, and numerous smaller weapons. Propulsion was by three sets of Parsons geared turbines of 110,000 total shaft horsepower taking steam from six 3-drum boilers to give the ship a speed of 31 knots. In addition to repairs, renewals and the fitting of new equipment, the ship has been completely rebuilt above the hangar deck and the conversion job has involved the removal of some 15,000 tons of steelwork, machinery and internal fittings which have been replaced by similar items weighing about 19,000 tons, so that 4000 tons have been added to the original displacement of 22,600 tons. The modifications to the flight deck have resulted in the extreme beam of the ship being now about 150ft and the depth from bottom of keel to the flight deck being increased by 4ft. Stability requirements have been met by adding blisters to the underwater form, which have been faired into the ship's lines and have increased the hull beam by approximately 8ft. The armament now consists of twelve 3in 50 calibre guns in twin mountings and other smaller guns.

As arranged the hangar is divided into two sections by an asbestos cloth fire curtain and there is a separate compartment which is allocated for the fitting up of air-to-air guided missiles. Two high-speed hydro-pneumatic-operated centre line lifts handle the aircraft between the flight deck and hangar deck levels and the usual servicing arrangements are fitted, while two electrically operated platform bomb lifts connect the bomb stowage with both the hangar and flight decks. The flight deck, which is a little over 775ft in length, has been built to incorporate a fully angled deck and an angle of 8¾ deg. has been achieved by extending the deck outboard to a distance of 41ft on the port side over a length of 120ft. This extension, which represents a compromise between the requirements for an efficient flight deck layout and the dictates of safety at sea, is supported by a sponson bracketed to the ship's structure. The strength of the deck is such that it can take the heaviest of Fleet Air Arm aircraft, including the Blackburn "N.A.39."

Port and starboard deck landing mirror sights are fitted, that to port being mounted well outboard on its own sponson, and sited to bring the aircraft in to land so as to pick up number 3 of the four arrester wires which have an average span of 80ft. A single "Nylon" emergency barrier is mounted. To get the aircraft into the air there are, at the forward end of the deck, two parallel track, and 145ft long, steam catapults complete with rapid positioning equipment and jet blast deflectors. Additional to the usual facilities there are selected positions on the deck for the supply of electric power, low pressure and cooling air for starting and servicing aircraft, weapons and weapon systems. The comparative smallness of the island, by present-day standards, is of particular note, and it has been carefully planned in order to ensure that the maximum area of flight deck is available for flying purposes. The siting of the two-tier operations room, radar display room, associated control rooms and rooms for personnel below the flight deck, has been the main factor in enabling the dimensions of the island structure being kept to a minimum. Another point of interest is the very large radar aerial which surmounts the structure. The reduction of the size of the island structure taken in conjunction with the angled deck extension has no doubt reduced the amount of unbalanced weight so that the amount of the ballast, usually carried to balance the island structure, may be reduced.

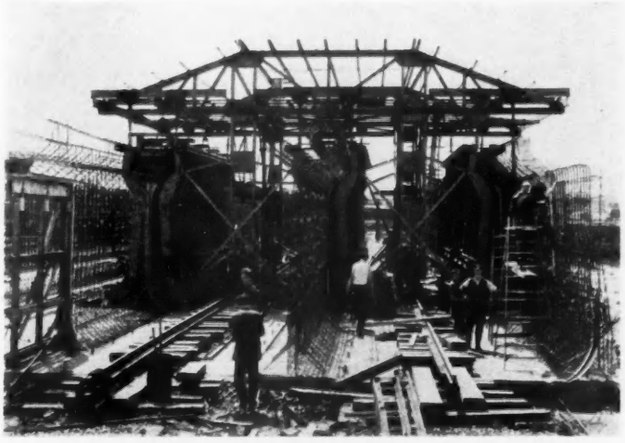
Attention has been drawn already to the radar aerial which serves the air defence radar system. This combines early warning and high discrimination of an aircraft's position in plan and height simultaneously, and the information provided is collected by a complex semi-automatic electronic system in which computers provide the greater accuracy required to control modern high performance fighters operating in large numbers. The results are transferred manually to a totalisator board which gives a tabular display of all aircraft, thus enabling the commanding officer to see at a glance the tactical situation over a wide area in any section of the sky. There is another new high discrimination radar with computer which has been fitted to "talk down" aircraft on to the deck in all weathers. The A.B.C.D. defence of the ship has been improved by the adoption of a grouped ventilation system incorporating fewer but larger fans and in a contaminated area they can be "crash" stopped and the trunking subsequently closed by quick-acting flaps. During the closed down period air filtration units permit a small quantity of fresh air to be supplied to the control centre.

The upper gallery deck, or number 2 deck, is a noteworthy development in that it is continuous for the full length and breadth of the ship, whereas previously this deck had been a narrow gallery external to the hangar. Located immediately below the flight deck it makes use of the deep beam system of the flight deck and the additional space provided has been used primarily for accommodation and mess spaces. The deck head is fully lagged because of the exposed deck above and the space is air conditioned. Throughout the ship the latest habitability standards have been worked to, as far as the accommodation plan commitments permitted, and include bunk sleeping for all ratings, dining halls for junior ratings, with separate messes for seniors. Many messes are air conditioned. All officers have single cabins.

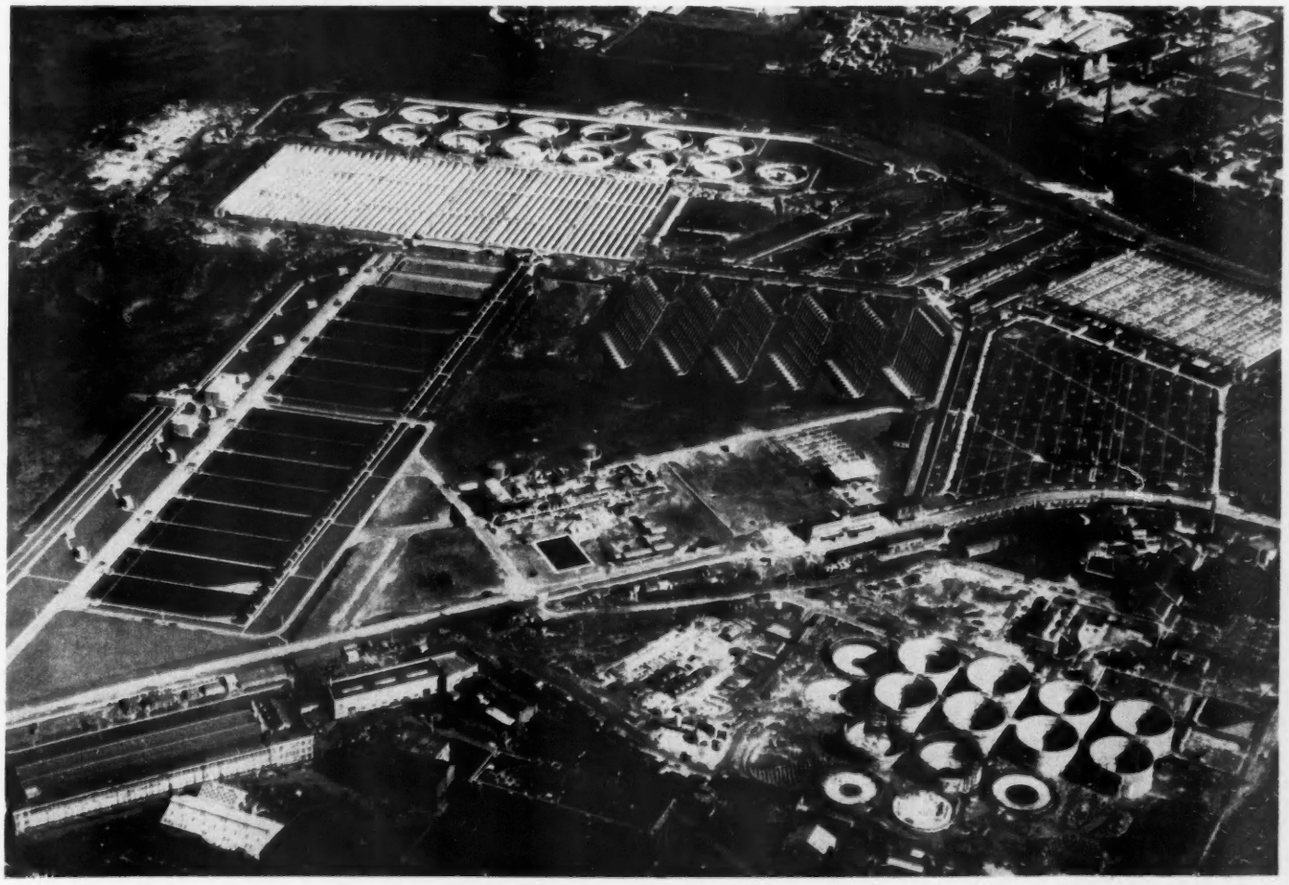
The original main geared turbine machinery has been retained, but the old boilers have been removed and replaced by six Foster Wheeler designed units arranged in one centre line and two wing boiler rooms and operating under open stokehold conditions. The steam conditions have been raised from approximately 350 lb per square inch and 650 deg. Fah. to 440 lb per square inch and 750 deg. Fah. Apart from other considerations the steam plant had to be increased in capacity to meet the greater demands of the additional equipment and services. These include steam for the

London's Northern Outfall Works

Old and new works at the London County Council's northern outfall at Beckton can be distinguished in the illustration below. To the left are the two inlet channels and sixteen primary sedimentation tanks completed in 1955. The secondary treatment plant, now under construction, will treat about 60 m.g.d. of settled sewage. Six sets of aeration channels, and behind them fifteen final settling tanks, can be seen behind the primary tanks. The two upper illustrations show the travelling shuttering used to construct, respectively, the walls of the aeration channels and the final tanks, the former constructing three 32ft lengths of wall to the full height, and the latter about a 20ft length, including two cantilevers, at one set-up. A full description of this aspect of the work was given in "The Engineer" of April 19, 1957. In the right foreground, tanks of the sludge digestion plant are shown under construction; the plant will consist of sixteen digestion tanks, four dewatering tanks, secondary digestion tanks, pumping stations and gas holders. To the left, the first shell roof of the power-house, which will have eight gas turbines, five air blowers, three alternators and other plant, can be seen

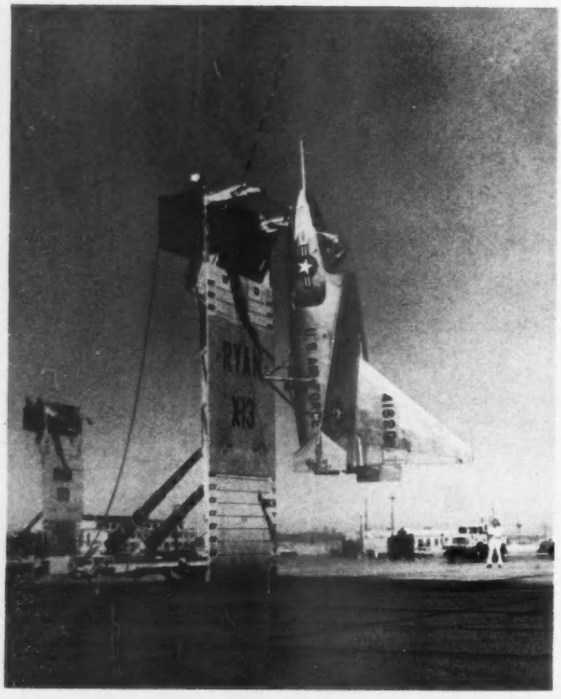


The five 9ft by 9ft trunk sewers serving the old works pass from left to right, below the road; covered sedimentation channels are shown on the right, with the old secondary treatment plant to their left, and re-aeration channels behind them. The L.C.C.'s chief engineer, Mr. J. Rawlinson, M.I.C.E., and his staff, designed the new works. Civil contractors, Richard Costain, Ltd., and the Demolition and Construction Company, Ltd.

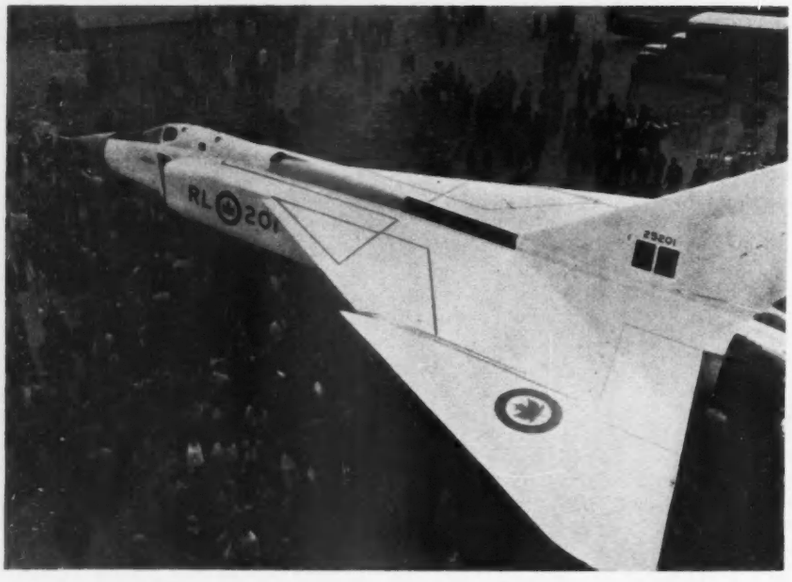


Military Aircraft

The Convair " F.106A " " Delta Dart," on the right, has an obvious resemblance to the " F.102A " " Delta Dagger," at present in use for the defence of the United States, but has a Pratt and Whitney " J.75 " instead of a " J.57 " ; other differences are that the intakes on the engine air ducts are further back, and have a variable geometry, and the fin is not pointed. The two seats of the " B " version are in tandem, not side by side. In its fully developed form, the aircraft will fly under the automatic control and monitoring of the semi-automatic ground environment, and discharge its missiles automatically at the dictates of a system on the aircraft. The pilot does little more than take off and monitor for failures



A really high-performance modern aircraft has thrust equal to a significant fraction of its weight, and without being too wastefully overpowered could be made to take off vertically. Such a scheme is readily acceptable for a tactical fighter; it may be expected that the emergence of long-burning-time, thrust-programmed, solid-fuel rockets will render it practical. Forerunner of such machines is the Ryan " Vertijet," seen, left, approaching to hook on to its wire " roost." It has a Rolls-Royce " Avon " engine, from which air is bled for the control jets ; auto-stabilisation is complete, and the aircraft is reported to be extraordinarily steady in the hovering mode. During 1957 the " X-13 " made the first sortie by a jet aircraft with vertical take-off and landing and conventional flight



Above: Convair " B.58 " " Hustler " with its weapons pad in place. The pad is finned and can be jettisoned in flight, a valuable provision in view of the extreme power consumption of supersonic aircraft. The " Hustler," powered by four General Electric " J.79 " single-spool engines, whose variable geometry intakes are visible, is not thrust-limited in level flight ; its maximum speed is dictated by kinetic heating. In configuration the aircraft is obviously similar to other descendants of the " XF-92 " delta, first flown in 1948.

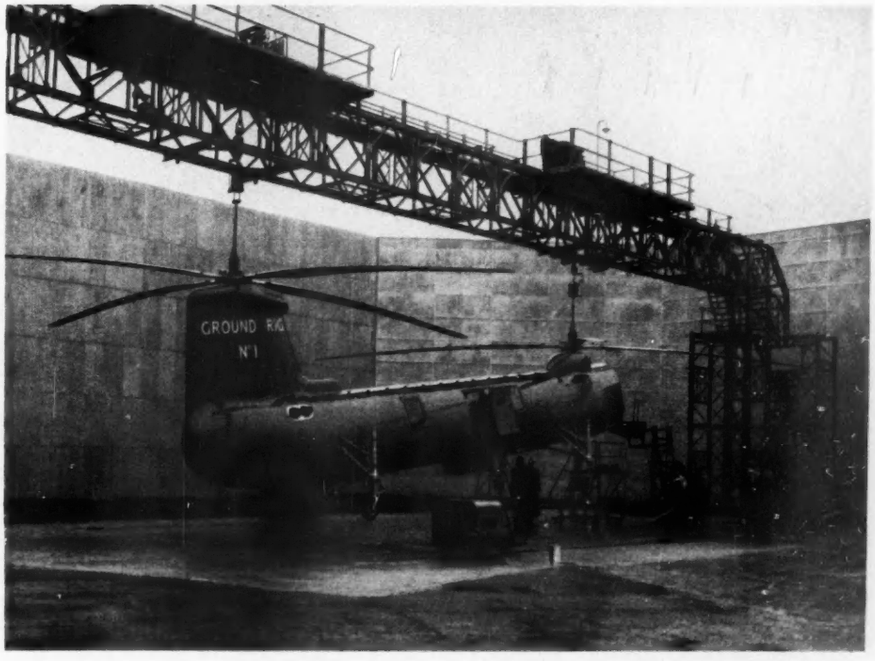
A delta of less simple aerodynamic form is the Avro "Arrow," a very large two-seater, all-weather interceptor, claimed to be able to destroy, with unspecified weapons, bombers flying at 75,000ft. As in previous Hawker Siddeley practice, the engines have been buried, and much interest attaches to the intakes. There are fixed ramps on each side of the fuselage with straight leading edges, and the outer lips of the intakes also have straight boundaries, in this case slightly rounded, so that the geometry is drastically two-dimensional ; it is not known what effect changes in incidence cause. The surface of the ramp just forward of the intake proper is perforated heavily over a length of perhaps one-third the duct width ; these holes communicate with a low-pressure area, and bleed away the boundary layer on the surface of the ramp. The wing makes an abrupt change of section at about half span; the leading edge is deeply notched

Rotorcraft

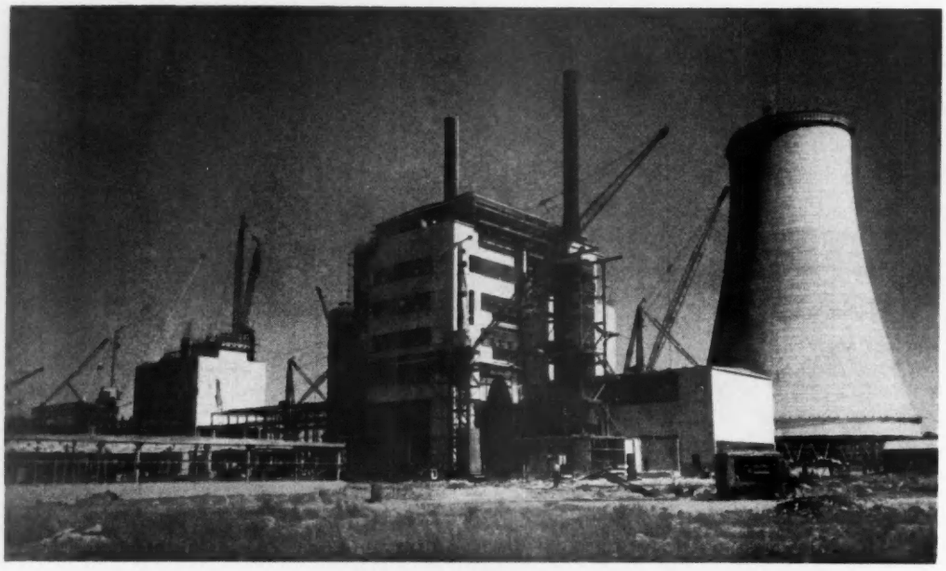
Late last year the Fairey "Rotodyne" took to the air, flying as a helicopter. The provision of a small wing which takes about half the weight of the machine when flying as an autogyro is expected to result in operating costs much lower than those of present rotary wing machines, while the use of small fields should allow journey times less than those of aeroplanes for short distances. The machine is powered with two Napier "Eland" single-shaft turbines, which, for low-speed flight, have their propellers taken to extreme fine pitch, the power passing through fluid couplings to auxiliary compressors which supply pairs of blade tip burners; yaw control is then by differential pitch change

In October last, a new helicopter world record for load to height was established by the Mi6, with a figure of 24,646 lb to 7874ft. This largest of helicopters is seen here with another product of the team led by Mil, the Mi1. The resemblance between the Mi4 and the Sikorsky S.55 is recalled by the likeness of the Mi6 to the S.56, one version of which, the Westland "Westminster," will have gas turbines; in each instance the Soviet aircraft is about twice as large. The design suggests that rather long and fast flights are envisaged; it can be seen that the rotor axis is tilted forward, the intakes for charge and cooling air face forward, and the main undercarriage is spatted. The illustration does not show flapping hinges, but what appears to be a drag damper can be seen. The blades are apparently riveted from unpainted steel, and made in three sections. The access panels to the turbines and transmission fold down to act as servicing platforms, and there are actually handrails along the top of the coamings. (Observe the man kneeling at the rear of the transmission fairing.) Three doors can be seen in the port side of the fuselage, and there are also clamshell doors below the tail boom. The boom is heavily cranked, and there is a tail skid at the rear of it.

Because of the ability of a gas turbine to stand heavy overloading for short periods, it is able to give engine-out safety to a twin-engined helicopter, which is therefore more attractive than a single-engined machine. A configuration which allows rather large c. of g. travel is the tandem rotor layout used by Bristol Aircraft, Ltd.; mechanical transmission is used throughout, with attendant high efficiencies, and since the fore-and-aft shafting is loaded only very lightly in normal flight it should not burden the maintenance schedule excessively. To develop the power systems before flying the "192," a pair of test rigs will be built, the first of which is seen here; it includes virtually a complete airframe, with two Napier "Gazelle" engines of 1650 h.p. and controls. The second test rig will be controlled remotely from a caravan on the site. The rig is suspended from a gantry made of Bailey bridge components, and thus the steady flight loads can be simulated. It is intended to carry out intensive endurance testing, and the rig is surrounded by a noise-reducing baffle

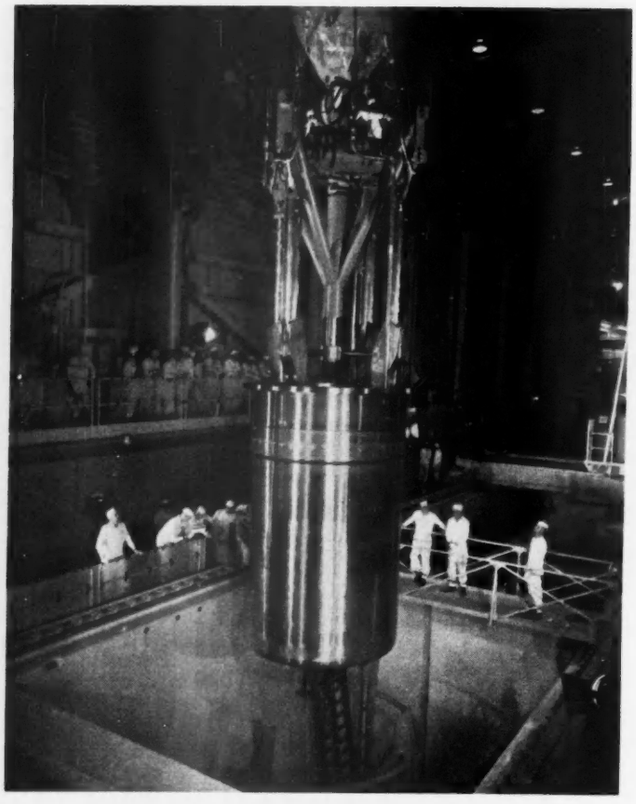


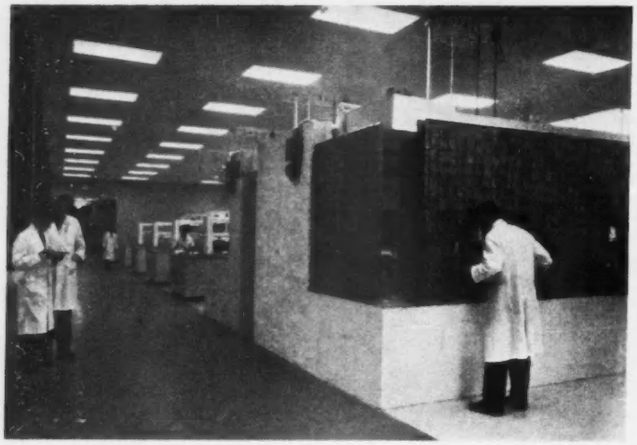
Atomic Energy



Calder Hall " A " station in Cumberland has now been producing plutonium and power since 1956, and Calder " B, " now under construction, also to have two reactors eventually, should start operating on one reactor in 1958. Four additional reactors for the production of plutonium and power, and working on the same general principles as Calder Hall, are being built at Chapelcross, Annan, Dumfriesshire, and the picture on the right shows progress on No. 1 reactor. Like those at Calder, the reactors at Chapelcross will each put out a maximum of 180MW of heat. It is planned that three of the reactors will start in 1959.

While Calder Hall is claimed to be the first nuclear power station in the world to generate electricity on an industrial scale, the pressurised-water reactor at Shippingport, Pennsylvania, U.S.A., which became critical on December 2, 1957, is said to be " the world's first full-scale central atomic power plant devoted exclusively to civilian purposes." The view right, shows the 58-ton core of the reactor being lowered into the underground pressure vessel. The clearance between the core and the pressure vessel being only 0·06in, several hours were spent in placing the core accurately. The plant fills a site of about one and a half acres about 30 miles from Pittsburgh; it has taken three years to build and has cost 80,000,000 dollars. After several weeks of testing to establish the characteristics of the reactor and the satisfactory functioning of the various components, it is expected that the output will be gradually increased until the peak of 231MW of heat and 60MW of electric power is reached. The output will be fed to the Pittsburgh area. The reactor uses very pure ordinary water both as the moderator and as the primary coolant. There are 165 lb of highly enriched uranium in the core, surrounded by a blanket of 14 tons of natural uranium. The pressure vessel is a cylinder of manganese molybdenum steel over 30ft high and weighing 235 tons ; it is clad internally with stainless steel, and its walls are 8¼in thick





The picture above, left, gives a general view of the isotope laboratory in the new technical building recently opened at the Radiochemical Laboratory, Amersham. The demand for radioactive products has been more than tripled in the last three years. Increased business and higher standards of safety have made it necessary to expand the establishment

The photograph reproduced at the bottom of the page was taken from the rear last March, during construction of the HIFAR test reactor for the Australian Atomic Energy Commission. Built at Lucas Heights, Sydney, this reactor is similar to DIDO at Harwell, using enriched uranium as fuel and heavy water as moderator. DIDO has now been operating for a year ; it provides a neutron flux of 10^{14} thermal neutrons per square centimetre per second at peak, and a maximum heat output of 10MW. A similar reactor has being ordered from a British manufacturer for Germany

Commercial Vehicles

The "Super Setra" coach seen on the right was built by Karl Kässbohrer Fahrzeugwerke G.m.b.H., Ulm, for the 4000-mile routes of the United States: running day and night, it is expected to accumulate 300,000 miles a year. It is of integral construction, weighing only 11 tons, with a steel frame and light alloy skin anodised, on the "Golden Eagle," gold. Front and rear suspensions are independent, but the centre wheels are mounted on a live axle: springing is by air in cylindrical bellows. The vehicle is driven by an eight-cylinder M.A.N. turbo-charged diesel with a six-speed ZF "Media" gearbox

The Berliet "T.100" truck has an unusual transmission. A differential on the centre axle drives a pair of crown wheel and pinion sets, and each pinion shaft is coupled to one in the rear axle: a differential in the transfer box drives each front wheel separately. Another differential acts between front and both rear axles, and all differentials can be locked. The engine is a Cummins V-12 of 1486 cubic inches (24·4 litres), developing, with twin turbo-chargers, 600 h.p. at 2100 r.p.m.: maximum brake mean effective pressure is 173 lb per square inch at 1600 r.p.m. The gross weights are 80 tons for a truck, 100 tons for a dumper, and 120 tons with a three-axle semi-trailer

Seen here engaged in transporting cattle in Australia, the Rotinoff "Viscount" with two trailers can carry up to 110 animals at a time. A six-cylinder Rolls-Royce diesel, supercharged, gives 250 h.p. at 2100 r.p.m. to a six-speed synchromesh gearbox driving both rear axles through a close-overdrive wide-reduction auxiliary box. The long cab accommodates a couch transversely behind the seats. The freighter-trailer vehicles have steering bogies at each end, connected by a rod linkage, and are each 45ft long. Running on tarmac roads, these combinations have proved able to make a 500-mile round trip every twenty-four hours, at an average fuel consumption of 4 m.p.g.

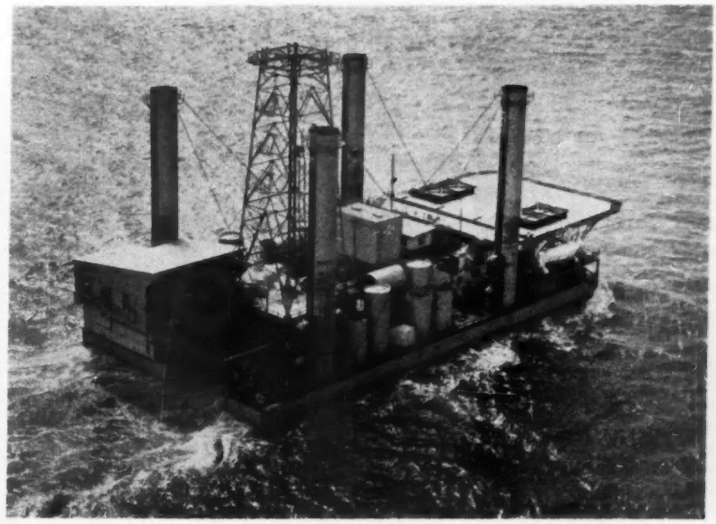
Continental Railways

Further progress with electric and diesel traction is shown by the three illustrations which we reproduce here. On the right is the German Railway's "E10," of which Kraus-Maffei, Munich-Allach, has developed and built the mechanical parts. Designed for heavy express service, the 85-ton, 150km per hour, B_0–B_0 locomotive is powered by four 810kW motors, totalling 4400 h.p., and giving a maximum tractive effort of 28 tons. The design is similar to the "E41" passenger and "E50" heavy goods locomotives, and many details are identical. Frame and integral superstructure are welded, as are the bogies. Measuring 16,500mm over buffers, the locomotive has a bogie centre distance of 7900mm, the bogie axles being spaced at 3400mm. All four driving axles run on roller bearings, with soft helical spring suspension. The spherical kingpin bearings are laterally supported by coil springs. Both driving cabs are temperature and sound insulated, and two side corridors render the electrical equipment easily accessible

A development of the B_0–B_0 "V200" locomotive, also designed by Kraus-Maffei in co-operation with the German Federal Railway, is the heavier C_0–C_0 "ML2200" diesel-hydraulic locomotive for Yugoslavia, which we show on the left. It is powered by two Maybach 1100 h.p. diesel engines, driving through Maybach-Mekydro and intermediate Kraus-Maffei gearboxes and universally coupled shafts. As on the "V80" and "V200" the bogies, with 3500mm axle distance, are kingpinless and guided by rubber-mounted linkages about an imaginary centre of rotation. Lightweight construction of the bogies and load-carrying frame resulted in an axle loading of only 16 tons. Bogie centres are 12,300mm apart, length over buffers is 20,500mm. The locomotive is built for a speed of 120km per hour, with a continuous full-load minimum speed of 15km per hour, and a maximum pull of 28·8 tons. Sides and cabs are effectively sound-proofed, and an automatic steam generator of American design produces up to 750 kg of steam per hour for train heating. Driving is from either end, and several locomotives can be coupled and driven from one set of controls

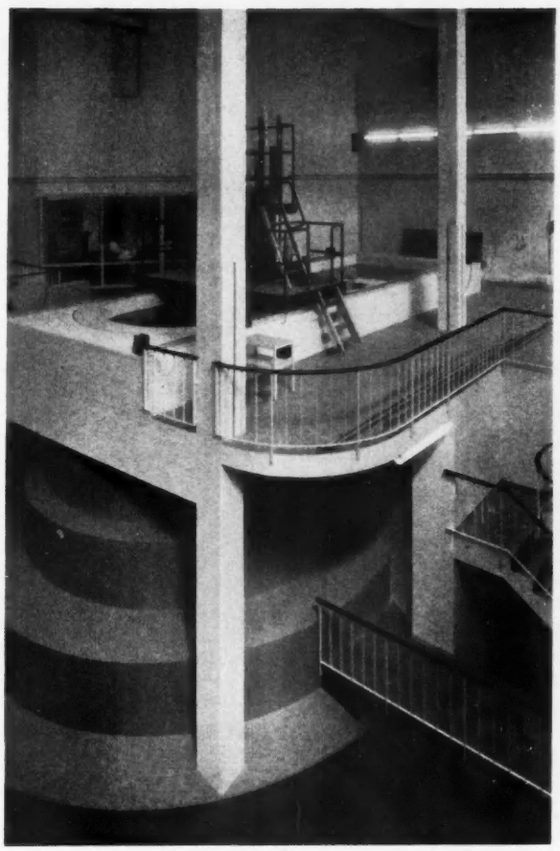
TEE—Trans-European Express—train sets were introduced during the year. Various makers are concerned with the different sets, which were built to a common minimum specification. Here illustrated is one of five Netherlands–Swiss trains, comprising a combined motor coach/luggage van by Werkspoor, Amsterdam, and three passenger coaches by Swiss Industrial Company (SIG), Neuhausen. Electrical equipment is by Brown, Boveri et Cie, Baden. Integral welded construction has led to a weight of 225 tons of the 97m long set. The motor coach is powered by two 1000 h.p., 1400 r.p.m., V–16 diesel engines of 160mm bore and 200mm stroke, each driving a 675kW/650V generator and 50kW, 145V auxiliary generator, each supplying two bogie-mounted traction motors. A 300 h.p., 270kVA diesel generator set supplies the lighting, heating and air-conditioning equipment. The train seats 114 people and includes a dining compartment seating thirty-two. It is air-conditioned and equipped with double windows

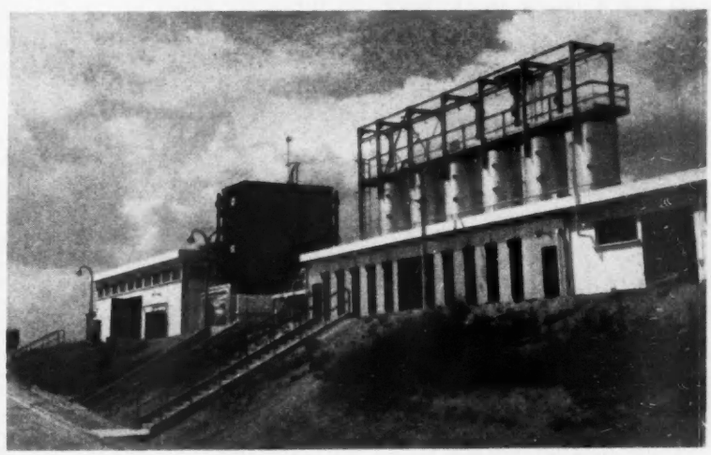
Continental Engineering



The 4800-ton drilling barge "Adma Enterprise" (right) was built for Abu Dhaby Marine Areas, Ltd., joint subsidiary of B.P. and Compagnie Francaise des Petroles, by Gutehoffnungshutte Sterkrade A.G., to the design of De Long Corporation, New York. The 190ft by 106ft by 15ft welded pontoon carries on a 24ft platform a 140ft derrick capable of drilling to 15,000ft. Four caissons of 10ft diameter by 165ft allow the structure to stand in up to 15 fathoms, the platform being raised hydraulically to 45ft above the water. In front of the derrick are housed four 400 h.p. "Paxman" diesels for driving the rig and ancillaries; to the left are the pipe rack, mud, chemicals and cement hoppers, power station, with three similar diesels driving 400V, three-phase, 50 c/s generators, laboratory and living quarters for fifty, overtopped by the 80ft by 80ft helicopter platform, which overhangs the bow by 36ft. A 30-ton mobile crane is used on board

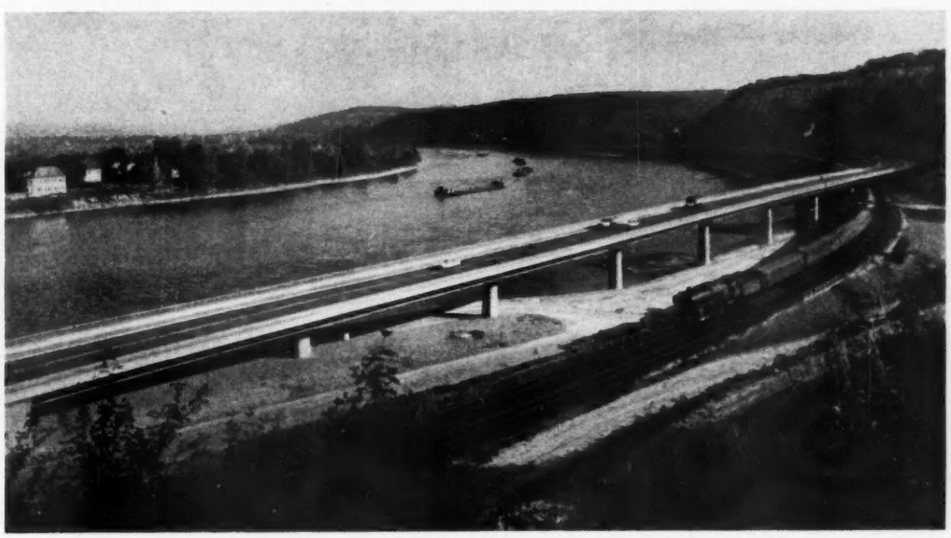
In July, the first Swiss research reactor (below), the swimming pool reactor "Saphir," came into operation. Belonging to Reaktor A.G., Wurenlingen, it has an internal flux of 10^{13} neutrons per square centi-





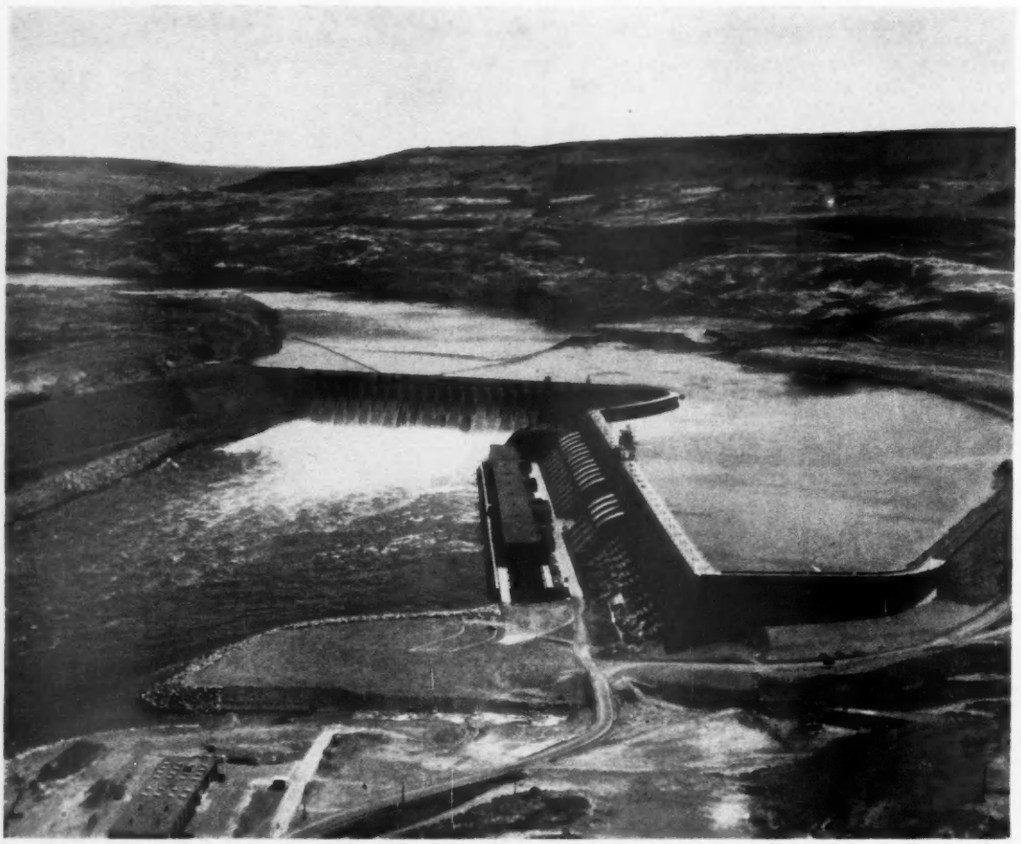
metre per second. Thermal output is 1000kW or more. Installed at the bottom of an 8m deep water tank shielded by up to 2·5m of barytes concrete, the core comprises twenty to thirty fuel rods of 20 per cent enriched uranium

If gas consumption continues its present growth, in 1961–62 the Paris region may require up to 10,000,000 cubic metres a day, of which only 7,000,000 could be produced locally and 1,000,000 would be imported from Lorraine. To store the remainder by traditional construction, gasholder capacity would have to be increased two hundred-fold. Gaz de France therefore investigated the possibility of underground storage. At Beynes, near Versailles was found a suitable permeable dome overlaid by impermeable clay. Above may be seen part of the installation where eventually over 300 million cubic metres will be stored, allowing deliveries of up to 2,500,000 cubic metres per day, at a cost of ½ per cent of traditional gasholders. Further reservoirs elsewhere in France are under study, and a similar scheme has since come into service at Reitebrook near Hamburg



On the left we show the Unkelstein viaduct between Bonn and Remagen. In place of the old crossing under the railway, which was always threatened by the River Rhine, the new road is a flyover. Its acute angle is facilitated by the single supports, as in the case of the Danube bridge at Mohringen (1954). It is a longitudinally and transversely prestressed, double box section with cantilevered sides, 15·10m wide, carrying four lines of traffic on a 13m carriageway. The nine 32·6m to 41·06m spans are anchored at the sixth support, resting elsewhere on rollers on the 5m diameter mushroom columns, with heavy end masses providing continuity moments

U.S. Water Power



Chief Joseph dam of the U.S. Army Corps of Engineers on the Columbia River in the State of Washington. The concrete gravity dam has a total length of 4300ft and a height of 230ft above the foundation. Here we show the nineteen tainter gates in operation on the 922ft long spillway. Twelve of the sixteen penstocks, each 25ft in diameter, are now in operation too and the twelfth turbo-generator set went into operation last October. Each penstock feeds a 100,000 h.p. turbine in the power station. Another set is scheduled to start operating this month and three more sets during 1958, thus completing the initial installation. Eventually a total of twenty-seven sets is planned

To the surprise of American construction circles, a relatively obscure local public utility authority—the Grant County Public Utility District—awarded one of the largest contracts in American history for the 178ft high Priest Rapids dam on the Columbia River in the State of Washington. Of the total length of 8412ft of the dam, 2427ft will be of concrete, and earth-fill embankments will extend over 5985ft. The 1142ft long spillway section will comprise twenty-two tainter gates, each 50ft high and 40ft wide. The power station will have initially eight turbo-generators with a total capacity of 630MW. The Wanapum dam, a "sister" project 18 miles up river, has a proposed 570MW capacity, so the ultimate 1200MW potential of the scheme will make it the third largest source of hydro-electric power in the United States. The Priest Rapids dam was designed by the Harza Engineering Company and is being built under a 92,000,000 dollar contract by the Merritt-Chapman and Scott Corporation

aircraft catapults, the four 1,000,000 B.Th.U. Foster Wheeler steam vacuum refrigeration plants, the additional generators, and the main heaters and local booster heaters in the ventilation trunking. Remote hydraulic control has been installed and the machinery control room is air conditioned and supplied with filtered air. To provide for the greatly increased demands for electrical power two 500kW Allen turbine-driven generators have been installed, in addition to the original six 400kW units, and also four 200kW diesel-driven generators, so that the generating capacity has been raised from 2400kW to 4200kW. The original d.c. ring main system has been retained and conversion machines have been provided to satisfy the varied requirements of a variety of services. In the switchboard room there is a central automatic indicator board for the ring main with two angled wing boards for outgoing supplies.

Double Duo Bar Mill

A PROGRAMME of modernisation and re-equipment has been in progress for some time at the Sheffield works of Sanderson Brothers and Newbould, Ltd., and the most recent piece of plant brought into operation under the scheme is a new 10½in double duo bar mill. This mill, which can be seen in the accompanying illustrations, will replace two existing mills and is intended for the production of high speed steels, tool steels and alloy steels. For the installation of the mill and its ancillary plant two existing buildings were joined together, and the new layout enables the ready transfer of finished bars to the heat-treatment and the bright bar turning sections of the works.

Five-stand 10½in double duo bar mill for high-speed, tool and alloy steel products. The finished hot bar removal conveyor can be seen in the floor in the foreground

Mill ancillary section with bar table leading to cooling furnace, which has a set of cooling tubes on the left side. The reeling machine for bars is on the right of the furnace

The mill was supplied by the Brightside Foundry and Engineering Company, Ltd., Sheffield, and has five stands, the last three of which can be used for finishing. It is designed for rolling bars up to 60ft long in sizes from ⅜in to 1¾in round, and equivalent bar sections and flats up to 3in wide. The rolling speed is 300ft to 900ft per minute.

The mill is driven by a 500 h.p. d.c. motor, the speed of which is controlled during rolling by the supervisor at a control desk adjacent to the roughing stand. This panel is equipped with a load indicating ammeter, a speed control regulator and an emergency stop button. The roll train is driven through a reduction gearbox coupled to combined mill pinions and a diagonal gear set. The five stands of double duo roll housings are connected by universal couplings, and provision has been made for the installation of a sixth stand if required. The cast iron roll housings have cast steel chocks and roller bearings. Springs and suspension bolts, which are used to balance the top rolls and their chocks, are adjusted vertically by forged steel screws which are operated by swivel levers and notched discs. Roll cooling is by means of pumped river water for which a tank is provided at each housing. Water is directed by flexible hoses on the rolls and scale is carried to a collecting pit which can be cleared as required.

To facilitate and speed the work of roll changing, spare housings are provided to enable two complete stands of rolls to be prepared in a separate assembly bed whilst the mill is in operation. A dust free assembly shop and roll store has been provided for the mill and in it the roller bearings are fitted into the rolls by an oil injection equipment.

Billets for the new mill are at present heated in a continuous pulverised fuel furnace and they are transferred by live roller gear to the roughing stand, hot cogging shears being provided for use when required adjacent to this stand. On the outgoing side of the last three stands, any of which can be used for finishing, there is provided in the floor a transfer equipment which moves the bars across to a live roller conveyor. The transfer equipment consists of seven chain skids ; the roller conveyor which carries the finished bars on down the shop to a hot saw can be seen in the foreground of the illustration of the mill. The hot saw is later to be replaced by a hot shear.

The outgoing bar table and a group of ancillary plant, to be seen in the lower illustration, is situated in a sunken section of the mill floor, an arrangement which facilitates handling the hot bars at floor level. Bars and flats pass straight on to a roller table in this section. Those which do not require slow cooling or reeling, are transferred to a straightening rack, from which they are subsequently removed by overhead crane. Bars requiring reeling are transferred to a second rack for passing through a hot reeling machine. Those which require furnace cooling are charged into a gas fired, temperature controlled furnace at the far end of the bar table or into a nest of slow cooling tubes at the side of the furnace. Bars which have to be heat treated are removed from this section in stillages to an adjoining heat-treatment bay.

Whilst the new double duo mill was in course of construction production was maintained by an old 10in mill driven by a steam engine. This old mill and its engine are to be dismantled when the new mill is in full operation and additional billet furnace capacity installed in its place.

LETTERS AND LITERATURE

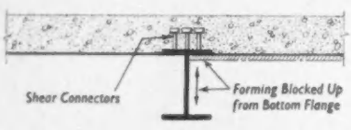
Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

COMPOSITE STEEL AND CONCRETE CONSTRUCTION

SIR,—I read with interest the article appearing in the November 1 issue describing the new development to take advantage of composite action between concrete slabs and supporting steel beams. Composite construction has been used in this country and the United States for several years with great success. The spirals used to transmit the horizontal shear and also to form a mechanical anchorage have been used in the U.S.A. under a patent and were known as alpha spirals. They were, however, welded to the top flange of the beams. In other words, the beams were not split as done by Messrs. Jenkins and Potter. It was mentioned that extra spirals may be welded to each end of the beam where the shear is greatest. Another method, which is certainly simpler, and has been used in most cases, is to alter the pitch of the spirals. The pitch for the alpha spirals varied between 4in and 16in, and the mean diameter varied from 3in to 12in, thus giving a wide variety of choice. If, however, the horizontal shear was greater than that which could be resisted by a 4in pitch then more than one spiral was used.

Shear connectors consisting of three studs, ¾in by 4in, welded on the top flange



Slab formed by blocking up from bottom flange

Some years ago, channels began to be used as shear connectors, again welded to the top flange of the beams and this became the standard method of construction for many provincial and state highway bridges, notably in Alberta. These shear connectors were thoroughly studied at the University of Illinois and design rules were obtained. In the past three years, however, a new shear connector has been developed in the form of a stud, which is instantaneously welded to the top flange of the beams. The normal method of stud welding is used. These studs have also been tested at the University of Illinois and design rules obtained. The method is very quick and economies are claimed. It is noticeable that three large bridges under construction in this province all use this method. I enclose a photograph showing ¾in studs, 4in long, used on the Oak Street bridge, Vancouver. You will note the head on the stud which provides the mechanical anchorage. The studs are just placed closer together as the horizontal shear increases.

The advantages of composite construction on large buildings and bridges are many and in nearly every case the initial cost is decreased, particularly on bridges where 3in saved in height can mean a great saving on approach earthworks. Also, of course, from the British point of view, there is a definite saving in steel. There is some merit in splitting the beam, thus taking full advantage of compression resistance of concrete and tensile resistance of steel, thus using both materials to their maximum advantage. However, in buildings, I believe it is still common in England to fireproof steel with concrete rather than lath and plaster and, therefore, concrete is poured around the beam, thus being monolithic with the floor slab. Here, in Canada, where material costs are low and labour is high, we do not split the beams and we fireproof with lath and plaster. Therefore, the slab is formed by blocking up from the bottom flange, as shown. This aids the contractor by having a clear working space underneath. By fireproofing with lath and plaster, a considerable saving is achieved in the dead load. Tests have shown that, with proper thicknesses of plaster and the right material components, any hourly rating can be achieved.

The best use of composite construction in this country would seem to be in bridge work, where a saving in height and steel can be achieved, although the stresses can be kept within those specified. And, at the same time, often the cost is less. Using the maximum size section, greater spans can also be achieved without the use of built-up sections. Using a 36in wide flange, beam spans of over 90ft have been built for highway loading. This Institute has constantly advocated the use of such construction, both in bridges and buildings, as we feel a sound and more logical engineering solution is provided to the client at cheaper cost.

JOHN WHEELER,
Canadian Institute of Steel Construction Inc.

Vancouver, B.C.,
November 28, 1957.

BALLISTIC ROCKET ERA

SIR,—I believe that a deterrent both less vulnerable and less costly than that described in your leading article on December 20, last year, may be readily encompassed. The "Polaris" is almost certainly rendered more costly by the provision for it to be fired from a moving deck, while it is undoubtedly further from final acceptance for service. If, however, vessels resembling the Landing Ships, Tank, of the last war were used as carriers, they could remain at sea, immune from any attack not immediately preceded by reconnaissance, until required to strike: they could then be beached to form a stationary launcher.

There should be little difficulty in fixing the exact position of a vessel in sight of land, so that one of the problems of the Fleet Ballistic Missile System disappears. Such carriers could use the same vehicles, "Jupiter" or "Thor," as the land bases, if these indefensible installations are to remain: the capital investment should be vastly less, since a ship is an ideal store for bulk fluids, and water to quench the exhaust in static motor testing will be available simply by opening the doors in the bows. I anticipate that it would be necessary to fly guidance units ashore at intervals for inspection and calibration, but the equipment for such tasks is likely to be so expensive that it would in any case be centralised between a number of sites.

"HINCHCLIFFE"

London,
December 31, 1957.

Book Reviews

Jane's Fighting Ships, 1957-58. Edited by R. V. B. BLACKMAN. Sampson Low, Marston and Co., Ltd., 25, Gilbert Street, Oxford Street, London, W.1. Price 105s.

IN an introduction to this Diamond Jubilee edition of the always reliable and up-to-date work of reference, *Jane's Fighting Ships*, the First Sea Lord emphasises that the publication of *Jane's* in any year is a red-letter day in the naval world. It is thus particularly fitting, he adds, that the sixtieth issue should coincide with the announcement of our first nuclear-powered submarine, the "Dreadnought"—the most dramatic naval development we have seen since the "Dreadnought" of fifty years ago. Whether the coincidence is of any great significance is perhaps open to question. For *Jane's* deals with all the navies of the world and—as this edition makes clear—the United States already has fifteen submarines, a carrier and a cruiser built, building or authorised and is asking Congress's approval for another four submarines—all with atomic power. The more noteworthy feature of the new edition is the great improvement in the format which has changed from the horizontal to the vertical. In its new shape, it can be read conveniently—like an ordinary book. Numerous additions have been made to the technical data and tables

and over 800 new illustrations have been inserted, either of newly constructed material and recently converted warships or in replacement of earlier illustrations. No doubt all these alterations and additions account to some extent for the increase in price to five guineas. But the main reason is more likely that the publishers could not continue to absorb the constantly increasing costs of production.

In the foreword summarising the main changes and developments in the principal navies of the world—which this year is particularly well and objectively written—the publishers suggest the possibility of nuclear powered submarines equipped with guided missiles replacing aircraft carriers within a few years as the spearhead of naval warfare. The immense increase in the efficiency and fighting value of submarines given by atomic power cannot be over-emphasised. But it is difficult to visualise an underwater vessel ever becoming the " capital ship " of the future. Faced with atomic depth charges, restricted to periscope vision (asdic and hydrophone are not satisfactory alternatives), limited in her capacity to carry armaments, equipment and stores, and liable if she appears on the surface to be put out of action by the 4in gun of a destroyer or frigate, even an atomic-powered submarine would not be of much value in guarding the sea communications. It is worth noting, also, that the larger the submarine, the easier target she is for asdic-fitted surface vessels.

In pointing out that, apart from having a huge submarine fleet, Russia has built since the second world war more cruisers and destroyers than all the nations of the rest of the world combined, *Jane's* does not attempt to explain what this large, powerful and fully manned fleet is for. Indeed, in the light of the new era of thermo-nuclear bombs and ballistic rockets, it seems an impossible problem to solve except by referring to Marshal Zhukov. " In a future war," he says, " the struggle at sea will be of immeasurably greater importance than it was in the last war." Now that the United States is building an atomic powered cruiser with an armament consisting almost entirely of guided weapons, it would be helpful if future issues of *Jane's* would distinguish more clearly between ships armed with offensive missiles and those armed with anti-aircraft guided missiles. The latter are now to be found in almost all kinds of United States fighting ships, whereas the offensive weapon—the flying bomb " Regulus "—is as yet fitted only in a few submarines and also, purely to supplement aircraft, in ten aircraft carriers. Moreover, the time is approaching when large ships and atomic-powered guided missile submarines will be armed with the " Polaris." Indeed, some months ago the former Secretary of the U.S. Navy implied that the era of the ballistic rocket firing submarine had already arrived and it has been generally assumed that three of the four new atomic-powered submarines asked for in the current naval programme are to be armed with this weapon. According to *Jane's*, however, they are to have the same type of armament as their conventional predecessors—the " Regulus " flying bomb. The range of the " Regulus " has been increased to 1000 miles, but it is, of course, nothing more than a supersonic jet fighter and liable to be shot down by A/A defences. Pages 72 to 112, dealing with the other Commonwealth Navies, make interesting reading. These navies are expanding rapidly and provide a substantial addition to the sea power of the Commonwealth.

Reports on Progress in Physics. Vol. XX, 1957. Executive editor A. C. STICKLAND. The Physical Society, 1, Lowther Gardens, Prince Consort Road, London, S.W.7. Price 63s. to non-Fellows, 27s. 6d. to Fellows.

PREPARED under the general supervision of the Papers Committee of the Physical Society, this volume contains nine reports. The first, from Imperial College, deals with the theory of plasma oscillations in metals. Here, after a review of previous treatments of the Coulomb interaction, the plasma theory is presented in a simple way, the author concluding with a semi-quantitative theory of the effects of the periodic lattice field and of the core electrons. The second paper emanates from the Clarendon Laboratory, Oxford, and gives an account of the theory of liquid ^{4}He. It is shown that the treatment developed by Landau and Feynman is adequate to explain nearly all the properties of the liquid, the principal problem being the behaviour at high rates of flow or when carrying a heavy current of heat. A paper from Harwell reviews recent experiments with protons having energies in excess of 100 MeV. Phase shift analyses of data from the study of proton-proton scattering below 400 MeV are said to indicate the general trend, and to have made model tests possible. The character of scattering changes at energies above 400 MeV. Existing explanations of experimental results, it is suggested, are over-simplified. A general discussion of theories of collective behaviour is presented in another contribution from the Clarendon laboratory.

The most massive individual work in the collection is American, a paper on K mesons and hyperons from the Enrico Fermi Institute in Chicago. This deals with both strong and weak interactions, and takes up 141 of the 566 report pages in a survey of empirical knowledge as it appeared at the end of 1956. An appendix (added when the paper was in proof) considers recent work on the non-conservation of parity. The Clarendon Laboratory is represented for a third time in this volume by a report on the microwave properties of solids. This discusses electron magnetic resonance techniques and considers recent experiments on cyclotron resonance in semiconductors. A review of high-speed methods, from Cambridge University, and a review of experimental and theoretical work on sensitivity, from Bristol University, form a duet of papers on photography. The last report in the collection, from Queen Mary College, London, deals with the theory and properties of solid argon. The dynamics and thermodynamics of inert gas crystals are discussed, and while agreement between theory and experiment is indicated in many cases, it is shown that further progress requires the extension of experiments to lower temperatures.

Cumulative author and subject indexes for volumes XVI to XX are given at the end of the book.

Gas Turbine Materials. By J. LUCAS and J. F. POLLOCK. Temple Press, Ltd., Bowling Green Lane, London, E.C.1. Price 25s.

FOR the metallurgist whose main concern is the use of materials at elevated temperatures, there is already available a number of books devoted to the study of heat resisting steels and alloys. Most of these books, however, are of a highly specialised nature and are of little interest to the gas turbine engineer who is not concerned with the theoretical aspects of material development. This book is described as " A Survey of High Temperature Materials and Their Application to the Gas Turbine," and as such its publication is welcomed. It should be read by all gas turbine engineers and particularly by the non-specialist metallurgist who is unfamiliar with gas turbines. Such readers will find the subject treated in a concise and interesting manner and cannot fail to profit from the information given.

In the opening chapter the authors discuss the development of materials for high temperature applications and the impact of the gas turbine on that development. The following chapter deals with the influence of performance requirements and fuel used on gas turbine operating conditions. The inclusion of references to design and performance requirements will be of little value to the gas turbine engineer but will be appreciated by the metallurgist. Chapter three is devoted to the discussion of metals under stress and temperature and it is rather disappointing to find no design curves for some of the more well-known materials such as the Nimonic alloys. In this chapter several pages are devoted to Vanadium Pentoxide and its effect on metals and alloys. Unfortunately, after having stimulated the interest of the reader the authors have omitted to give a single reference at the end of the chapter to this most important subject. In discussing erosion on page 85 it is said that in a steam turbine it is essential to avoid the use of steam containing the slightest trace of water droplets since otherwise rapid erosion of the blading will occur. This is somewhat misleading since the presence of water in an L.P. turbine cannot be avoided and with high peripheral speeds erosion shields must be used. The remaining chapters are devoted to the application of high temperature materials, and special high temperature materials, including ceramics, cermets and protective coatings, and finally the manufacture of gas turbine components is discussed. There is an appendix of compositions of British and American alloys which would be much improved if subdivided into casting and forging alloys.

In a book of this nature there are bound to be differences of opinion between author and reader. For example, the use of aluminium bronze for marine and land-based gas turbine compressor blades is referred to on page 91, but experience has proved such a material to be unsatisfactory. Again, on page 101, the authors list as the first requirement of a material for heat exchanger tubes a high thermal conductivity. With thin-walled tubing the variation in thermal conductivity has little effect on the overall efficiency of a tubular heat exchanger. These criticisms are, however, of a minor character and do not detract from the value of the book to all who are connected with, or just interested in, the development of gas turbines.

Books Received

B.B.C. Handbook, 1958. British Broadcasting Corporation, Broadcasting House, London, W.1. Price 5s.

Careers for Girls in Engineering. The Women's Engineering Society, 26, Victoria Street, Westminster, London, S.W.1. Price 15s.

Industrial Television. By H. A. McGhee. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 15s.

Spannbetonbau. By Wolfgang Herberg. B. G. Teubner Verlagsgesellschaft Leipzig, C.1, Goldschmidtstrasse 28 (Postschdiersfach), East Germany. Price DM. 26.

Obituary

SIR ALLIOTT VERDON-ROE

ON January 4, Sir Alliott Verdon-Roe died at the age of eighty. Born at Patricroft in 1877, Edwin Alliott Verdon-Roe was educated at Saint Paul's School, and at the age of fourteen and a half travelled to British Columbia to learn surveying with a civil engineer. On his return he spent five years as an apprentice in the locomotive works of the Lancashire and Yorkshire Railway, and subsequently sailed as an engineer for two years. He then entered the motor industry as a draughtsman and designer. In the model aeroplane competition held by the *Daily Mail* in 1907, he received the highest prize awarded.

Verdon-Roe then built a full-size aeroplane with which he succeeded in making a flight at Brooklands in June, 1908. However, he shortly afterwards abandoned the pusher aircraft and constructed the famous tractor triplane, which was flown at Lea Marshes in 1909 ; from then on he held to the tractor principle, chiefly with biplanes, and saw it achieve preponderance in world aviation. The first machine had both main and tail surfaces in the triplane configuration, but in 1911 he built a biplane which was followed, in the next year, by the Avro " 504," with an 80 h.p. Gnome engine. This machine was developed with conspicuous success, remaining in service for over fifteen years and being followed by others with a family likeness. In 1912 also he built a cabin monoplane and then a cabin biplane, which was the first enclosed aeroplane to fly. A series of biplanes with 50 h.p. Gnome engines were the first aeroplanes designed and built in this country to be delivered to the Army. Other Avro biplanes bombed the Zeppelin sheds at Friedrichshafen in 1914, and one brought down a Zeppelin in aerial combat. During the first world war the " 504," with 100 h.p. Gnome and other rotary engines, together with the " Gosport System " of flying instruction, satisfied an immense demand for pilot training, and, at least until instruction of crews for the second world war began in America, more pilots had been trained on Avros than any other machine.

Training aircraft did not occupy the firm of A. V. Roe and Co., Ltd. exclusively, however, and in 1915 there was designed a two-seater fighter with a performance outstanding at that time. In 1916 the twin-engined Avro " Pike " was evolved for the Royal Naval Air Service, a three-seater with two free gun mountings which was described as a fighter-bomber, and more powerful versions were the first Avro models to carry the name " Manchester." The " Spider " single-seat fighter, described then as " wireless," was a strut-braced sesquiplane, with the cockpit in between the spars of the main plane.

In 1918, Verdon-Roe was appointed O.B.E., and in 1928 he was knighted. He sold his interest in the firm he and his brother had founded and associated himself with one of the few firms building flying boats for the Air Ministry, subsequently known as Saunders-Roe, Ltd. The Saro " Cloud " and " Cutty Sark " were amphibians, but twin-engined flying boats, such as the " London," the wartime " Lerwick," and the " SR/A1 " jet fighter, were the main product of the firm. The marine craft culminated with the great " Princess " flying boats that are still in existence.

One of Verdon-Roe's persistent interests was the application of aerodynamics to the motor-cycle, and in 1922 he produced a monocar, a single-track vehicle in which the rider had a bucket seat. The first model, with a Barr and Stroud sleeve-valve engine, had small outrigger wheels for stability at low speeds. These were discarded in the later " Uno," which had much larger wheels with the springing actually inside that at the front. More recently he modified a " LE " Velocette to an open-frame design, giving the rider much increased weather protection. Another interest of his later years was monetary theory and the possibility of reform to reduce the burden of debt upon the economy and to establish the prerogative of the State over currency creation ; he was a vice-president of the Economic Reform Institute.

VISCOUNT WAVERLEY, O.M.

A BACKGROUND of education in the sciences has not often, in the past, been favourable to success in public life. Since that fact has often been raised in criticism of custom, it is particularly pertinent to recall that such a background was enjoyed by one of the most prominent and able of British administrators, Lord Waverley, who died on January 4, at the age of seventy-five. *The Times* says of him that " no single adverse criticism can justly be recorded of his administrative capacity or his cool judgment."

John Anderson was born at Eskbank, Midlothian, in 1882, and educated at George Watson's College, Edinburgh, Edinburgh University, and Leipzig University. He had a distinguished early career in the civil service, and held many important posts. He was knighted in 1919. In the nineteen twenties he was under-secretary to the Lord Lieutenant of Ireland, and later permanent Under Secretary of State at the Home Office. In 1932 he became Governor of Bengal, and was particularly successful in furthering the stability and progress of that region at a critical time. When his term of office was over, he became, in 1938, the Member of Parliament for the Scottish Universities. Governmental appointments—as Lord Privy Seal, Secretary of State and Minister of Home Security, and later as Chancellor of the Exchequer—followed through the war years. His name is associated particularly with his work at this time, which included the introduction of the Anderson shelter : this was evolved to meet a requirement for a shelter that could be erected with a minimum of skill in any garden and would be cheap to mass-produce. The final product, to the designs of the late Sir William Paterson, composed chiefly of corrugated steel sheets, was familiar throughout the country.

But it is in the later stages of his career that Sir John Anderson's work became of especial interest to engineers. He was the member of the War Cabinet carrying responsibility for scientific research bearing on the war, including applications of nuclear physics. Amongst the many honours which he received, Fellowship of the Royal Society may be especially noted here, an award which was in recognition of this wartime work.

The post-war phase of Viscount Waverley's career (he was raised to the peerage in 1952) is of special interest to the engineering world. He became chairman of the Port of London Authority in 1946, a position he held until his death, and was also chairman of the committee set up in March, 1953, to inquire into the causes of the storm and tidal surge which wrought such severe damage and loss of life earlier that year. He showed especial interest in the civil engineering aspects of the work of both the Waverley Committee and of the P.L.A., and was generally present when their work was discussed at Institution meetings, to which he also contributed in discussion. Lord Waverley will also be recalled with affection by the many delegates to the Nineteenth International Navigation Congress held in London last July, for he was president of the British organising committee of the Permanent International Association of Navigation Congresses, and of the Congress itself.

The Order of Merit was conferred upon Lord Waverley less than a month ago. He was then in hospital, where the insignia of the order was handed to him by the Queen's private secretary.

ALASTAIR McLEOD

WE have learned with deep regret of the death of Mr. Alastair McLeod, which occurred at Ruislip last Friday, January 3. Mr. McLeod, who was fifty-eight, was well known as a technical journalist whose special interest was in the ferrous and non-ferrous metal industries. For over twenty years he had served on the staff of Industrial Newspapers, Ltd., and, at the time of his death, was head of the metallurgical editorial staff of the group.

Alastair McLeod was born in Edinburgh and received his metallurgical training in Scottish steel works. Thereafter he worked for several years for Frederick Braby and Co., Ltd., in Glasgow, and for other sheet steel rollers in Scotland. The experience thereby gained and added to during the subsequent years of his career led to Mr. McLeod being regarded as one of this country's acknowledged authorities on rolling mill practice. McLeod left the land of his birth and came to London in 1937 to join Industrial Newspapers, Ltd., as editor of *Sheet Metal Industries*. Subsequently he became managing editor of that journal and of *Metal Finishing Journal* and *Metal Treatment and Drop Forging*, and chief metallurgical editor of *Iron and Coal Trades Review*.

There were numerous services rendered to metallurgy by Mr. McLeod in addition to his work for the journals with which he was associated. He was a Fellow of the Institution of Metallurgists, and a member of the Iron and Steel Institute, the Institute of Metals, the Institute of Welding, the Institute of British Foundrymen, the Institution of Production Engineers, and of the Refractories Association of Great Britain. In the course of his work, Mr. McLeod travelled extensively not only throughout this land, but also on the Continent of Europe, where he was very well known in metallurgical circles. One country, we believe, which he had never visited was the U.S.A. For some years, Mr. McLeod had been a member of the Electrochemical Society and of the American Association of Iron and Steel Engineers, and it was a great disappointment to him that he was unable to visit Pittsburgh last year to present in person, at the annual convention of the latter association, a paper which he prepared on " The Technical and Economic Position of European Steel Making To-day."

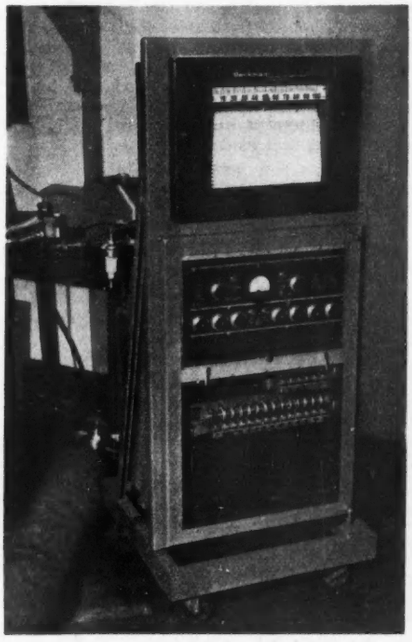
Frequently, at technical meetings and works visits, it was our pleasure to meet Alastair McLeod. He was an able metallurgist and a capable writer. Moreover, he was a genial and kindly soul. We know that in technical journalism and in the metallurgical industries, there are many who share our regret at his death.

SHORTER REPORTS

Instruments for Process Control

PRODUCTS of the American firm of Beckman Instruments, Inc., and its German subsidiary were shown recently under the auspices of Winston Electronics, Ltd., Shepperton, Middlesex. Dr. H. Righi, head of the German branch, gave a short talk on process control and the virtues of the four instruments displayed. The instruments shown, in order of novelty, were an industrial gas chromatograph, an electrolytic hygrometer, a leak detector and a gas analyser.

Dr. Righi stated that the application of gas chromatography was very new, though the principle was known thirty years ago. The name arose from the existence of a similar analytical method used with liquids ; there the components were separated by colour reagents, a dark brown or grey colour becoming unmixed into red,



Automatic chromatograph for continuous sampling and analysis of gas mixtures

yellow, blue, &c., on passage of an electric current. With gases the method was to pass a carrier-borne sample through a tube, possibly of copper, filled with an absorptive material such as silica gel, charcoal or aluminium oxide. The carrier gas was inert to the filling material. According to their differing affinities, the various components of the sample would be differently retarded by the filler and would leave the tube at different times. The separated components could then be detected. In the Beckman chromatograph the method was periodically to tap off a sample from the process line by means of an automatically-operated piston valve. A measuring cell in the sampling loop passed pure carrier gas and carrier-plus-sample alternately, while only carrier passed through a reference cell. Thermistors in the two cells were arranged to sense changes in the thermal conductivity of the gas in transit, and, connected in a Wheatstone bridge network, they gave zero net signal when carrier was passing through both cells. The unbalance of the bridge when carrier-plus-sample was in passage through the measuring cell depended on the nature of the sample, and therefore enabled identification of the separated components of the latter. The instrument had been developed in the U.S.A. because it was required to monitor a chlorine stream of about 95–97 per cent concentration, and the desired accuracy of within ±0·25 per cent could not be attained with existing equipment. Work had started more than three years ago, and the device evolved had now been in service in the Union Carbide and Carbon Corporation plant for two-and-a-half years. Dr. Righi imagined that that company had by now installed about sixty-five to seventy-five of such instruments. The concentration of chlorine could be measured within 0·1 per cent.

The electrolytic hygrometer shown by the speaker was for the monitoring of humidity in streams of gas. These instruments worked in a maximum range of 0 to 2000 parts per million, he said, which was far less than normal atmospheric humidity ; 0–2000 p.p.m. would represent up to 0·1 per cent humidity in a gas. The lowest range was 0–10 p.p.m., and the instrument was suitable for temperatures and pressure ranges up to 100 deg. Cent. and 0·7–7 atmospheres, respectively.

The gas analyser demonstrated by Dr. Righi used infra-red radiation to detect carbon dioxide. The sample was introduced to the measuring cell and beams passed through this and a reference cell containing standard gas (in this case nitrogen with 3 per cent carbon dioxide) were compared. This analyser was not as versatile as the chromatograph : for example, it could not measure both carbon dioxide and oxygen. The leak detector shown by Dr. Righi employed helium as the search gas.

Ross Spur Motorway

IT has been announced that work on the Ross Spur motorway will start in the spring. This motor road will be 20 miles long and will give a better route for traffic between the Midlands and South Wales. It is estimated to cost about £6,000,000. Tenders for the first two sections, totalling 10 miles, have been accepted the Ministry of Transport and Civil Aviation states, and contract documents are being prepared. The first contract is for a length of 7 miles, including a 1½-mile by-pass at Ross, and will be let to Tarmac Civil Engineering, Ltd. The second contract is for 3 miles at the eastern end of the motorway, and includes a bridge nearly ½ mile long over the River Severn ; it will be let to A. E. Farr, Ltd. Both of these contracts will take about two and a half years to complete, and two further contracts for the remainder of the motorway are timed to start six months later and to be completed in two years.

At its eastern end the Ross Spur will connect with the Worcester–Gloucester Trunk Road, A.38, north of Twyning. Eventually, it will be extended to join the proposed Birmingham–Bristol motorway. The western terminal will be at a point on the Worcester–Ross Trunk Road, A.449, about 1½ miles north-east of Ross.

The road will be of the standard associated with motorways—dual 24ft carriageways, hard shoulders, and no connections with the existing road system except at its ends and at two flyover junctions, one at Jay's Green, where the Ross–Newent Road B.4221 crosses over the motorway, and the other at Bury Court, where the Ledbury–Gloucester Road A.417 crosses it.

At Queenhill a bridge 2466ft long will be built to carry the Ross Spur over the River Severn. This bridge will have a central span of nearly 240ft over the river and two side spans of just over 130ft each ; these spans will be of steel construction with a reinforced concrete deck. The approaches will have nine spans on the west bank and fifteen on the east bank, all of reinforced concrete construction and each spanning about 82ft. The bridge will have a navigational headroom of 44ft.

Between the proposed Ross Spur and the Ross by-pass is a short length of existing road, A.449. This will be widened to accommodate two carriageways, uniform in width with those on the new roads. The Ross by-pass will lie on the north side of Ross, linking the motorway with trunk roads A.40 (leading to Newport) and A.49 (leading to Hereford) at Wilton. The by-pass will also have two 24ft carriageways, and although it will be constructed as an all-purpose road, the number of side turnings will be kept to a minimum, it is stated. Where the by-pass crosses the River Wye at Bridstow, a prestressed concrete cantilever bridge will be built, with a 203ft span over the river and two 75ft approach spans.

The design of Queenhill Bridge has been prepared by Sir Alexander Gibb and Partners and Sir William Holford ; Bridstow bridge has been designed by Messrs. Scott and Wilson, Kirkpatrick and Partners and Mr. Arthur Bailey. Other bridges in Gloucestershire have been designed by Messrs. W. S. Atkins and Partners. The remainder of the work has been designed for the Ministry of Transport and Civil Aviation by the agent authorities, the County Councils, whose county surveyors are Mr. D. H. Banks (Herefordshire), Mr. E. C. Boyce (Gloucestershire), and Mr. W. R. Thomson (Worcestershire).

Safety in Mines Research

THE thirty-fifth annual report of the Safety in Mines Research Establishment, which has just been published (H.M. Stationery Office, 4s.), deals with activities in the year 1956. It surveys the Establishment's researches on explosives and blasting devices ; explosion and fire hazards ; engineering and metallurgical matters, and dust control and pneumoconiosis. There is also some account of the Establishment's testing services.

Introducing the report, Mr. H. T. Ramsay, director of the Establishment, says that mining research has been in progress for a long time and the easier answers have usually been found. Real advances against the remaining hazards, however, will only be made by a penetrating study of their mechanisms and, so far from becoming easier, one may expect the Establishment's work to become more difficult. Mr. Ramsay recalls that during 1956, the Establishment began its move into new premises at Broad Lane, Sheffield (THE ENGINEER, May 10, 1957). The new building there houses the engineering sections and also the majority of the technical information services. Already this extension of the Establishment's premises has proved to be a great help in solving an acute accommodation problem. One aspect of that problem, Mr. Ramsay remarks, is that it has resulted as much from increasing the strength of the research teams to the necessary extent, as from the increasing complexity of the work.

Motor Vehicles and Corrosion

THE Corrosion Group of the Society of Chemical Industry has arranged a Symposium on the Protection of Motor Vehicles from Corrosion, to take place at the Institution of Mechanical Engineers, 2, Birdcage Walk, London, S.W.1, on Tuesday and Wednesday, March 11 and 12, 1958.

Ten papers, dealing with the engine, cooling system, electrical accessories, and bodywork of vehicles, and with packaging for export, will be presented for discussion by representatives from the British motor industry and research organisations. Preprints will be available to those registering as participants and paying the conference fee of 10s. for members of the Society of Chemical Industry and 40s. for non-members.

Further particulars and forms of registration may be obtained from the Society of Chemical Industry, 14, Belgrave Square, London, S.W.1.

C.E.A. Generating Plant Installed in 1957

In its last year of operation the Central Electricity Authority (whose functions were taken over on January 1 by the new Electricity Council and the Central Electricity Generating Board) was responsible for the installation of new generating plant with an output capacity of 1788MW. This result compares with the record figure of 1797MW achieved in 1956 and is nearly three-and-a-half times the amount commissioned during the first year of public ownership ending March 31, 1949. The new plant commissioned in the power stations owned by the South of Scotland Electricity Board had an output capacity of 84MW, making a total of 1872MW of generating capacity provided in the area of the former British Electricity Authority.

The additional C.E.A. plant, comprising thirty-five turbo-generators with an aggregate installed capacity of 1903MW, and forty-one boilers, having an aggregate evaporative capacity of 15,950,000 lb per hour, was installed in twenty-eight power stations. Four of them are new stations, in which plant was installed for the first time. Of the forty-one new boilers, two having an aggregate evaporative capacity of 1,100,000 lb per hour were oil fired. In addition, at four existing coal-fired stations eight boilers with an aggregate evaporative capacity of 2,860,000 lb per hour were converted to oil firing. Details are given in the accompanying table.

A new record in speed of construction was set up by the commissioning of the first 60MW set at Rogerstone power station exactly three years after work started on the virgin site, the second and last set being brought into service three months later. Another achievement was the commissioning during the year, by three different turbine makers and two different boiler makers, of five 100MW units, all of 1500 lb per square inch steam pressure, which can be regarded as prototypes of the larger generating units which will come into service at intervals during the next five-year period for which the Central Electricity Authority have finalised plant installation programmes.

The peak demand met by the Authority during the year was 19,311MW, which was supplied at full voltage and frequency at 5 p.m. on Monday, December 16. This was 1643MW above the peak load met at the beginning of the year, and was over 124 per cent above the peak demand of 8607MW met in England and Wales in the year before April 1, 1948. The Authority has explained that the amount of generating plant due to be commissioned in 1958 will be substantially less than in recent years because of the capital investment cuts imposed on the industry two years ago.

Heat and Power Generation

A 1000 h.p. Hick Hargreaves vertical compound steam engine, installed in 1885 in the Belfast mill of J. and T. M. Greaves, was replaced in 1956 by a Mirrlees, Bickerton and Day "KSS.6" oil engine. The works has a large demand for heat as well as power, and, therefore, much of the heat release of the diesel engine has been directed to the generation of steam at 4 lb to 5 lb per square inch gauge. The engine runs successfully on heavy oil fuel; with Brown Boveri turbo-charger and intercooler, it develops 1470 h.p. and is direct coupled to a 1030kW Brush alternator.

The boiler is a smoke tube Spanner "Swirlyflo," 4ft 6in diameter by 7ft long, designed for a maximum evaporation rate of 4000 lb per hour. This evaporation rate is calculated on 2000 lb per hour from feed water at 120 deg. Fah., when passing 17,600 lb of exhaust gas per hour at 850 deg. Fah. with the engine on full load developing 1470 b.h.p. The remaining 2000 lb per hour is produced by the heat dissipation from the circulating water. The cooling water is arranged on a closed circuit passing from the engine through the exhaust gas boiler and returning to the engine via an electrically driven centrifugal pump, at a rate of 24,000 gallons per hour. The temperature of the water entering the jackets is 228 deg. Fah. and there is an 8 deg. temperature rise through the engine, giving a circulating water temperature to the boiler of 236 deg. Fah. at full load.

The outlet temperature of exhaust gas from the boiler is approximately 600 deg. Fah.; the exhaust gases are led from the boiler to the main flue of two existing Lancashire boilers and passed in series through a feed water economiser, process water economiser, and air heater for a drying loft, before passing to the atmosphere via the main stack at 200 deg. Fah. approximately.

There is a separate circulating water circuit which supplies the turbo-charger intercooler and the lubricating oil cooler in series; the heat absorbed in this circuit is being used in the mill either for heating or process hot water.

The engine is designed to run on heavy fuel normally; but during starting up and closing down periods of approximately thirty minutes the engine will run on class "A" diesel fuel. The oil being used on this particular installation is commonly termed boiler fuel, with a viscosity of 3500 seconds Redwood No. 1 at 100 deg. Fah., and a gross calorific value of 18,350 B.Th.U. per pound. The heavy fuel oil is drawn from the main storage tanks at a temperature of 90 deg. to 100 deg. Fah., and passed through a 5kW thermostatically controlled electric heater, where its temperature is raised to 220 deg. Fah., prior to centrifuging. From the centrifuge the fuel is pumped to a daily service tank of 800 gallons capacity, where its temperature is maintained at 190 deg. Fah. Fuel from the daily service tank is then drawn off by gravity feed to a small circulating pump; this pump is on a closed circuit and the fuel passes through a 3kW thermostatically controlled heater, where its temperature is raised to 235 deg. Fah. The main fuel pumps are fed from this closed circuit and since the fuel oil is in circulation the temperature remains constant at 235 deg. Fah.

In September, 1957, a trial lasting one and a half hours, at an output of 1006kW and a turbine inlet temperature of 1032 deg. Fah., established the following heat balance :—

Work to generator	35·33
Heat :	
To steam	29·1
To feed water economiser	11·8
To process water economiser	4·45
To air heater	1·72
To space heating	8·93
Heat losses, radiation and flue	8·67
Heat from fuel	100·00

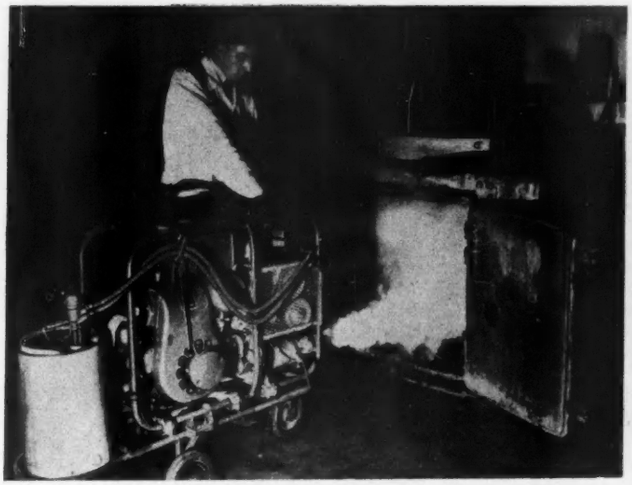
This indicates a gross thermal efficiency of 91·33 per cent, but pumps and other auxiliaries required 3·33 per cent, giving a net heat utilisation of 88 per cent.

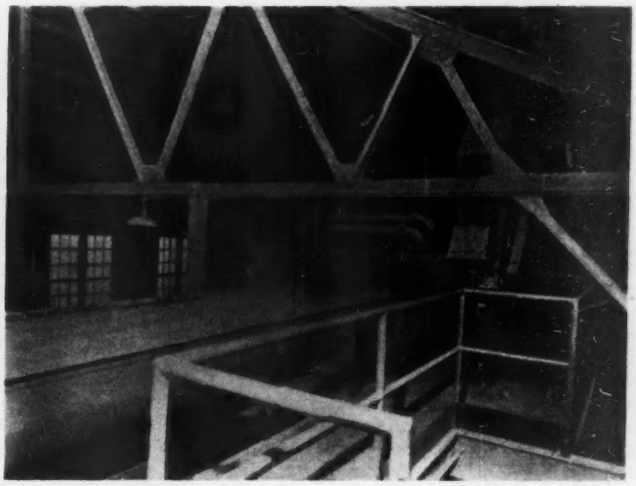
Generating Plant Commissioned by the Central Electricity Authority in 1957

The items listed below, complete with all associated ancillary equipment, have been commissioned during the twelve months of the year 1957

Name of power station	C.E.A. divisions	Turbo-generator plant		Boiler plant		Main high pressure pipework
		Installed capacity in MW	Maker	Capacity in lb per hour	Maker	Maker
Steam plant :						
Acton Lane "B"	London	2 × 30	Richardsons, Westgarth	2 × 240,000	Mitchell Eng.	Aiton and Co.
Barking "C"	London	—	—	1 × 540,000	Babcock and Wilcox	Aiton and Co.
Bold "A"	North Western, Merseyside and North Wales	—	—	1 × 300,000	Yarrow	Aiton and Co.
Brighton "B"	South Eastern	1 × 60	Richardsons, Westgarth	2 × 320,000	Babcock and Wilcox	C. A. Parsons
Carmarthen Bay	South Wales	—	—	1 × 240,000	Babcock and Wilcox	Stewarts and Lloyds
Castle Donington	East Midlands	3 × 100	Metropolitan-Vickers	2 × 830,000	Babcock and Wilcox	Aiton and Co.
Chadderton "B"	North Western, Merseyside and North Wales	1 × 60	Metropolitan-Vickers	2 × 360,000	Simon-Carves	Stewarts and Lloyds
Connah's Quay	North Western, Merseyside and North Wales	1 × 30	C. A. Parsons	1 × 300,000	International Combustion	John Thompson
Deptford East H.P.	London	1 × 52·5	Metropolitan-Vickers	—	—	John Thompson
East Yelland	South Western	1 × 31	C. A. Parsons	1 × 180,000	John Thompson	C. A. Parsons
*Ferrybridge "B"	Yorkshire	1 × 100	C. A. Parsons	1 × 760,000	Stirling Boiler/Babcock and Wilcox	Stewarts and Lloyds
Goldington	Eastern	1 × 30	British Thomson-Houston	1 × 300,000	Clarke Chapman	Stewarts and Lloyds
Hackney "B"	London	1 × 30	C. A. Parsons	1 × 300,000	Simon-Carves	C. A. Parsons
Hams Hall "C"	Midlands	3 × 60	General Electric Company	3 × 550,000	Simon-Carves	Stewarts and Lloyds
Huncoat	North Western, Merseyside and North Wales	1 × 30	General Electric Company	1 × 305,000	Simon-Carves	C. A. Parsons
Lincoln	East Midlands	2 × 20	Brush	4 × 120,000	Richardsons, Westgarth	Aiton and Co.
Marchwood	Southern	1 × 60	English Electric Company	1 × 550,000	John Thompson	John Thompson
Meaford "B"	Midlands	2 × 60	British Thomson-Houston	1 × 515,000	Babcock and Wilcox	Babcock and Wilcox
Mexborough	Yorkshire	2 × 30	English Electric Company	3 × 180,000	Richardsons, Westgarth	Aiton and Co.
Nottingham H.P.	East Midlands	1 × 60	Metropolitan-Vickers	1 × 300,000	Mitchell Eng.	Aiton and Co.
Ocker Hill	Midlands	—	—	1 × 180,000	Babcock and Wilcox	Aiton and Co.
Portishead "B"	South Western	2 × 65	Metropolitan-Vickers	3 × 300,000	Mitchell Eng.	Stewarts and Lloyds
*Rogerstone	South Wales	2 × 60	C. A. Parsons	2 × 550,000	Babcock and Wilcox	Babcock and Wilcox
*South Denes	Eastern	1 × 60	Metropolitan-Vickers	1 × 550,000	International Combustion	Stewarts and Lloyds
Tilbury "A"	Eastern	2 × 60	C. A. Parsons	2 × 540,000	John Thompson	John Thompson
Wakefield "B"	Yorkshire	1 × 60	English Electric Company	1 × 550,000	Foster Wheeler	Aiton and Co.
*Willington "A"	East Midlands	1 × 100	English Electric Company	1 × 830,000	International Combustion	Aiton and Co.
27 stations, including 4 new stations	11 divisions	34 turbo-generators having an aggregate installed capacity of 1893MW		41 boilers, having an aggregate installed capacity of 15,950,000 lb per hour		
Hydro plant : Dolgarrog	North Western, Merseyside and North Wales	1 × 10	Boving and Co.			

* In these new power stations plant has been commissioned for the first time in 1957. The others are existing stations to which extensions have been made.





(Left) Fog being introduced to the ashpit of a boiler furnace in a London power station. The operator controls the quantity and can switch the machine on and off as required. Leaks are revealed by the emerging fog. (Right) " Holo-Flite " heat exchanger for cooling 25 tons of salt an hour. The screws are completely immersed in the material in the trough

Testing Boilers for Leaks

SEVERAL factors contribute to the efficient consumption of solid fuels in boilers, but one that can dissipate the joint contributions of all others is the uncontrolled supply of air during combustion. The cause is traced usually to air leaks in the boiler casing. The methods used to detect such leaks are varied, and range from a candle flame or soapy water to smoke bombs and compressed air. In the more elementary techniques, lighted candles are held along casing joints, burners, furnace doors, ashpits, and so on, and the wavering of the flame indicates leaks, or soapy water is applied to the outside of the casing so that bubbles can reveal them. Smoke bombs are a comparative innovation. The bombs are placed in the furnace, and after they have burned for some time a pressure of up to 1 in w. g. is built up. This forces the smoke out of any leaks that are present. Effective as it is, the method has two disadvantages. The boiler must cool down sufficiently for a man to enter the furnace to place the bombs, and there is no way of regulating the amount of smoke generated once the bombs have been ignited. Thus, if there are many leaks, maintenance staff may have time only to mark a few before being forced away by the smoke.

These disadvantages are claimed to have been overcome by the " Tifa " fog-making machine, which was first designed for the dissemination of insecticides in aerosol form. The amount of fog emitted into the furnace can be controlled by the operator of the machine, it is stated, and the material used for producing a fog (Shell " FR80 " hydraulic fluid, for instance) will not sustain combustion ; tests can therefore be started within an hour or so of drawing the furnace fire. The method was developed by one of the major public utility companies in the United States in conjunction with the Todd Shipyards Corporation, the makers of the original machine.

Fogging tests for boilers have now become a recognised practice in the United States, we are informed, and one company is reported to have four units in operation for routine boiler inspection. It is estimated that these four machines show an annual saving of £35,000. We understand, from the Lister Todd Engineering Corporation, Ltd., of Dursley, Gloucestershire, that since it introduced the method to the United Kingdom, machines have been supplied to eight of the eleven divisions of the late Central ElectricityAuthority.

After the boiler has been " bottled up " by closing dampers, observation doors and any other apertures, a flexible metallic hose connected to the fogging head of the machine is inserted through a convenient opening, the point of entry being sealed to prevent the escape of fog. Sometimes fog can be introduced directly from the head through such openings as ashpit doors (see illustration). Fog builds up inside the boiler and emerges visibly through the leaks. Staff can seal the leaks immediately or mark them for future repair. The natural draught of the boiler, together with the air blast of the machine, is normally sufficient to disperse the fog, but it may be necessary to pressurise up to a maximum of 0·5in w.g. to force fog through very fine leaks. The amount of fog required depends on the size of the boiler, but the " Lightweight Tifa " produces approximately 10,000 cubic feet of fog per minute, it is claimed, and a boiler of 100,000 cubic feet capacity would need ten minutes' treatment. In practice, however, boiler-house superintendents of the C.E.A. are reported by the company to have found that three to four minutes is sufficient in the first instance, followed by short bursts to complete detection of leaks. The method also makes it possible to check any special section of a boiler system—for instance, a superheater. The overall weight (250 lb) and manœuvrability of the machine allow use on boiler-house galleries, and awkward positions are reached by attaching extra lengths of hose.

Screw Conveyor Heat Exchanger

A LICENCE has been obtained by the Holden Division of W. C. Holmes and Co., Ltd., Huddersfield, for the manufacture in this country of the " Holo-Flite " processer, or heat exchanger. This form of heat exchanger is designed to combine a large heat exchange area with a minimum use of space. It consists of a screw conveyor with helical hollow flights through which the heat transfer agent is circulated. This conveyor moves the material to be heated, cooled or dried at a uniform predetermined rate along a trough.

The screw conveyor is driven from one end and at the other end rotates in a manifold incorporating the heat transfer agent inlet and outlet ports. In operation the agent is introduced into an annular chamber which is formed along the length of the conveyor body between the walls incorporating the hollow flights and a central return tube. Thus, as the conveyor carries the material along the trough its particles are subjected to constant movement by the screw surfaces through which a flow of heat exchange agents is maintained.

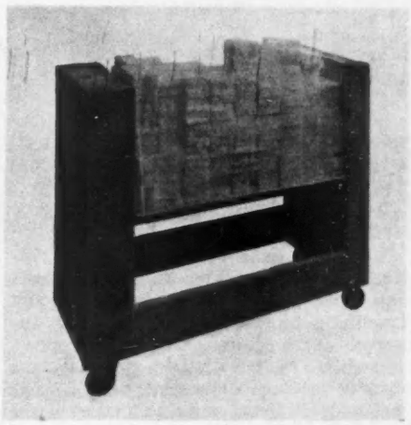
Although this form of heat exchanger can be supplied as a trough with a single screw, it is more usual to have an installation with two or more pairs of the hollow helical screws. In such cases the screws are intermeshed and grouped in multiples of two, with alternately right and left-hand screws rotating in opposite directions, to give the maximum amount of active heat transfer per unit of length of the trough. Screws are made in a range of diameters from 5in to 18in and in different metals to suit particular applications and conditions. The overall lengths of heat exchanger units of this design range from 15ft to 33ft, with effective trough lengths from just under 9ft to 18ft. Operating pressures up to 150 lb per square inch can be used in the screws, and their speed of rotation is generally between one and twenty r.p.m.

As already mentioned, these installations can be used for cooling, heating, drying and calcining materials, and a number of applications in service are given by the manufacturers. In one installation for cooling 25 tons of solar salt per hour from 250 deg. to 130 deg. Fah., the complete unit, shown in our illustration, occupied only 300 cubic feet of space. In another plant used for cooling 7 tons of cottonseed press cake per hour from 285 deg. to 89 deg. Fah., the total floor area required was only 30 square feet, with a height of 9ft.

Compensated Level Platform Table Trolley

WE illustrate below a trolley the table of which levels automatically when being loaded and unloaded. This is now made by Barron and Shepherd, Ltd., 16, Blackfriars Lane, London, E.C.4. This trolley of sheet steel construction has a 35½in by 23½in table, which is supported in the main framework on a system of springs.

As packages are placed upon the platform the springs are compressed to maintain the normal



Trolley with spring-supported platform which maintains a constant loading level

loading height at a predetermined level. The platform is designed to descend as loaded from a level of 36in to 11in, and can take up to 600 lb when fully loaded. Adjustment for lower load ratings is simply made by removing springs from the platform support assembly. The trolley is carried on 4in diameter wheels, which leave sufficient space under the base for lifting by a fork truck if required.

Industrial and Labour Notes

Future of the Steel Industry

The chairmen of two British iron and steel companies have commented this week, in their annual statements, about the Labour Party's declarations on the re-nationalisation of the iron and steel industry. Mr. A. G. Stewart, chairman of Stewarts and Lloyds, Ltd., says that the Labour Party must be well aware that there is little confidence in nationalisation in this country. The iron and steel industry, he continues, is tired of being treated like a shuttlecock. The threats to which it is subjected by the left wing are doing incalculable harm to the industry, both at home and overseas, one immediate result of the threat of nationalisation being that capital for further expansion becomes more difficult to raise.

By every reasonable test that even the most ardent nationaliser could apply, Mr. Stewart observes in his statement, steel is serving the nation well. Prices are among the world's lowest, production has exceeded the most sanguine estimates, and labour relations are a model for the rest of industry. Since the war, the industry has invested about £740,000,000 at current prices in one development after another. This, the statement adds, has been achieved largely out of the industry's own resources with the help of the private investor. What more could nationalisation do, Mr. Stewart asks, save to throw the burden of future investment on to the ordinary taxpayer ? The existence of a strong Iron and Steel Board, the statement emphasises, provides a general supervision over the industry sufficient to safeguard the interests of the community, and within this supervision the steel companies should be free to exercise their initiative and enterprise without bureaucratic interference.

The chairman of Dorman Long and Co., Ltd., Sir Ellis Hunter, makes similar observations in his annual statement. He says that the Labour Party's declared intention to re-nationalise the steel industry ignores the outstanding contribution the industry has already made to the well-being of the nation, and is continuing to make under the supervision of the Iron and Steel Board appointed by the Government. By providing increasing supplies of steel at highly competitive prices, the steel industry has, both directly and through exports of manufactured goods by home consumers of steel, done much to fill the gap left by coal and textiles in our export trade.

Industrial Relations and Wages

In our issue of November 15, 1957 (page 722), we noted some suggestions about wage claims which were made by Viscount Chandos in his presidential address to the Institute of Directors. The main proposal outlined by Viscount Chandos was that there might be a wage agreement covering five years and giving an annual increase in the basic wage of, say, 2½ per cent per annum to every employee who had served his " reference period " of a year or two. The 2½ per cent would be calculated not upon earnings, but upon the basic wage rate, and would be part of an agreement that no wage claims would be advanced during the five years.

In the January issue of *The Director* (the official journal of the Institute), three trade union leaders have commented upon Viscount Chandos's proposal. They are Sir Thomas Williamson, vice-chairman of the Trades Union Congress, Mr. Alan Birch, chairman of the T.U.C. economic committee, and Mr. W. J. Carron, president of the Amalgamated Engineering Union. Sir Thomas Williamson's view is that the suggestion appears to be an attempt to limit the scope of collective bargaining ; he says that it is the legitimate function of a trade union to protect and wherever possible improve workpeople's living standards. Any proposal to alter the present system of collective bargaining, Sir Thomas urges, must be examined with the utmost care. Mr. Birch puts forward the opinion that Lord Chandos's suggestion for a wages policy does at least have one merit in the eyes of a trade union official—it contemplates a regular increase in wages. Too much of contemporary thinking and utterance, he adds, gives the impression that a solution to our problems is to be found in freezing wages ; that, he believes, is both economically and psychologically bad.

Mr. Carron, in his observations, says that to give effect to the suggestion would be extremely difficult but not impossible. In engineering the method used to determine remuneration would permit regulation of the consolidated time rate by long-term progressive agreement plus some agreed factor to compensate for increases in the cost of living. Existing procedures which determine the pay packet by discussion within individual companies need not be affected, Mr. Carron says, and that would to a large extent enable adjustments to differentials and piecework prices or times to continue to be dealt with domestically. This policy, Mr. Carron continues, would not be easy to put over ; it would no doubt be " strongly opposed by those who have no desire to see industrial peace in Britain." Mr. Carron then expresses the opinion that it would benefit British industry considerably if a really equitable means of distributing the benefits of scientific and technological advance could be devised. That, he believes, would eliminate periods of uncertainty and friction culminating possibly in large-scale disruption of production and hitting the whole community. Mr. Carron concludes his observations by saying that Lord Chandos's formula would not be a complete panacea, " but if it should promote thinking and discussion which would lead to greater industrial stability and peace with justice to employer, employee and consumer, then his contribution will be a milestone in history."

Agricultural Machinery

The Agricultural Engineers Association has announced that last year's exports of British agricultural machinery reached a total value of over £90,000,000, the highest annual figure recorded in the industry. It compares with £70,000,000 in 1956 and £1,500,000 in 1938. Home market sales last year, the Association adds, were valued at £66,000,000.

The general trend of exports, the Association says, is very satisfactory. Over the first ten months of 1957 the value of farm machinery exports to various countries were as follows, the comparative figures for 1956 being shown in parentheses : France, £1,595,470 (£903,300) ; Eire, £1,268,220 (£1,261,580) ; New Zealand, £1,123,030 (£889,030) ; Yugoslavia, £1,020,730 (£386,898) ; South Africa, £557,510 (£556,480) ; Belgium, £293,230 (£242,200) ; Italy, £258,743 (£181,410). Among the machinery exported, combine harvesters, tractor ploughs and planters and seeders have shown marked increases. Furthermore, the Association states, the British tractor manufacturers have improved their sales in several countries. British tractor exports to Scandinavian countries have risen substantially and in Austria they are now 35 per cent ahead of German tractor sales.

Coal Statistics

At the end of last week, the National Coal Board issued a statistical statement setting out the results of its activities in the third quarter of last year. In that period, it is estimated that the deficit on revenue account amounted to approximately £8,147,000.

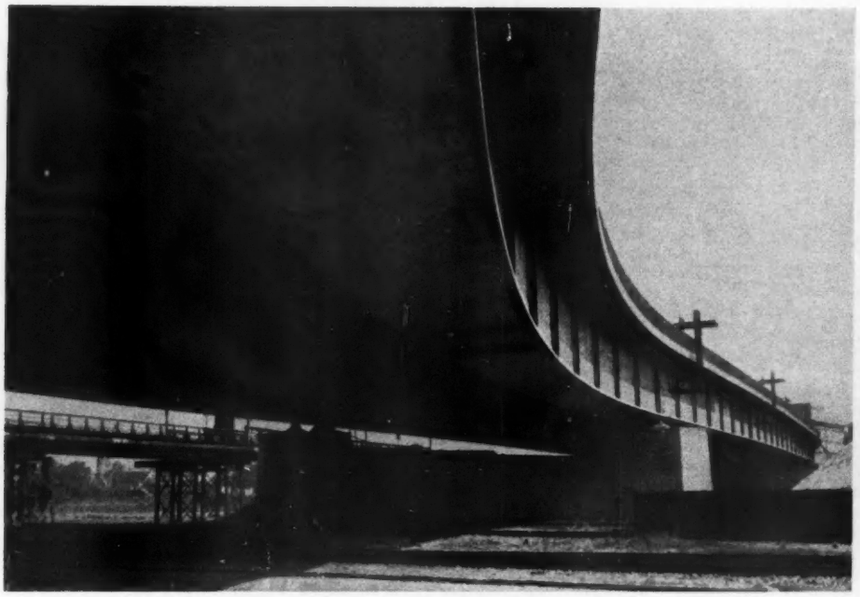
The saleable tonnage of coal from the Board's mines in the third quarter was 44,685,913 tons, of which the amount " disposable commercially " was 42,067,165 tons. The proceeds from the sale of coal were £188,483,691, but the total costs of getting it were £193,838,766, so that, before charging interest, there was a loss of £5,355,075. The estimated profit on opencast working during the quarter was £2,859,000 and on the operation of the Board's ancillary undertakings £774,000, which reduced the colliery loss figure to £1,722,075. A reduction in provision for taxation brought the loss down to £1,531,075, but to that there had to be added the sum of £6,616,000, the amount of the interest payable to the Minister of Power. Among the statistics included in the statement are those setting out average earnings in the mines during the third quarter. When the value of allowances in kind is taken into account, the average weekly earnings of all underground workers were £14 8s. 10d. and of surface workers £12 14s. 4d.

In presenting the statement the Board points out that the third quarter results are always adversely affected by annual holidays. Last year, however, despite the increase in selling prices on July 1, the results were influenced by other factors. Among them was the influenza epidemic, which caused heavy losses in output before the end of the third quarter.

Scientific and Technical Translation

A one-day conference on scientific and technical translation is to be held at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2, on Wednesday, March 5. This conference, which is being arranged by Aslib, will survey the position of scientific and technical translation from various aspects, bearing in mind that organisations and individuals at all levels—international, national, industrial, commercial and personal—are occupied with the work and that the need for the interchange of information is a matter of urgency. It is hoped that as a result of the conference, there may be elimination of much wasteful duplication of effort and closer co-operation between all concerned. The subjects for discussion are : the organisation and availability of technical translation ; the economics of translation, and training and education.

Further particulars of this conference are available from Aslib, 4, Palace Gate, London, W.8.



Neckar Bridge at Mannheim

Last year the new Jungbusch Bridge, over the River Neckar at Mannheim, was opened to traffic. This 245m long box girder steel bridge, with deck of steel and prestressed concrete, has a 114·4m long main span over the river and at right angles to it, together with two side spans of 62·9m curving away in opposite directions, with radii of curvature of 170m, so that the bridge has the shape of a reversed letter "S." Immediately adjacent to the northern side span, which crosses the Neckar foreshore, is a separate bridge of 29·9m span with supports near its centre. This bridge, which crosses a railway line and a road, is even more strongly curved and has a radius of curvature of 130m.

The new design replaces a war-destroyed bridge dating from 1906, which comprised two three-jointed concrete side spans and a central steel arch. It has a 14m wide roadway flanked on either side by 2·5m wide cycle paths and 3·5m wide pavements. The spans measure 64·12m+114·4m+64·42m along the centre line. The elevation of the central span is parabolic, but twisted to obtain opposite superelevation of the deck at the two ends, amounting to 4 per cent. Constant superelevation of this amount is given to the curved side spans. The two main girders are continuous box girders, the height of which increases parabolically from 2·9m at the supports to 3·45m at the centre. For the given layout it appeared that the cheapest way of constructing the deck was to have a steel deck connected with the girders, and on it a non-connected, longitudinally prestressed, but laterally simply reinforced, concrete deck. The main girders are completely welded, also the construction joints, except the two which, after floating in the central section, had to be closed quickly, and which accordingly were riveted. Set at a centre distance of 20·6m, the main box girders are joined by a total of eighty-three cross members spaced at a distance of about 3m. These are arranged radially on the two side spans. The bridge deck is free to move horizontally, independently of the main girders, by virtue of the fact that the main span cross members are connected to the box girders by flexure pivots, while the side span cross members, because of the need for torsional rigidity, are linked on by elastic frameworks. These two kinds of members are situated underneath the cycle paths, which, together with the sidewalks, form the top flanges of the box girders. A rigid connection between girders and deck is provided at the bridge centre.

The concrete deck is 50cm thick over the side spans and 18cm over the central span. On top of the concrete was placed a 3cm thick layer of asphalt.

The prestressed deck is dowelled to the steel deck. Prestressing was carried out from the middle outwards in both directions, deflections due to tensioning of the cables being reduced as much as possible by bending the steel deck in the opposite direction before concreting. In order to take up the torsional forces, heavy cross girders are used at the supports. The deck is able to slide over the top flange of these girders. Because of the torsion there is a tendency for the outer bearings at the supports to lift which is counteracted by the prestressing of the cross girders. This was done by opening a joint and applying hydraulic pressure until the required deflection was obtained, when the joint was riveted up again.

Services carried under the bridge include high-tension and telephone cables, gas and water mains, and drainage. Two steam mains for district heating are to be installed later. Provision has been made for inspection of cables, &c., inside the box girders, while those services which are carried under the cross girders, as well as the structure itself, can be inspected either from fixed cat walks or from an underslung, petrol-driven, travelling cat walk, which, in the curves, runs on wheels of unequal diameters, and in the straight portion on wheels of the same diameter.

Prefabrication of the box girders was carried out in the workshop, where forty-four sections, ranging in length between 7m and 14m and weighing up to 35 tons, were prepared. While the side spans were assembled on temporary trestles, the central girders were first preassembled into lengths of 52·28m and 64·15m, weighing respectively 140 and 180 tons, and floated into position by a 250-ton and a 40-ton floating crane. The required butt joints were riveted.

For the main S-shaped bridge, the amount of steel required was 1540 tons, while the adjoining small bridge, which has an orthotropic steel deck, needed 262 tons; these quantities are equivalent respectively to 0·242 and 0·282 ton per square metre of deck. The bridge was designed by the Gustavsburg works of M.A.N., and carried out by this firm and its associates, notably Grün and Bilfinger, Mannheim (concrete supports and concrete bridge deck).

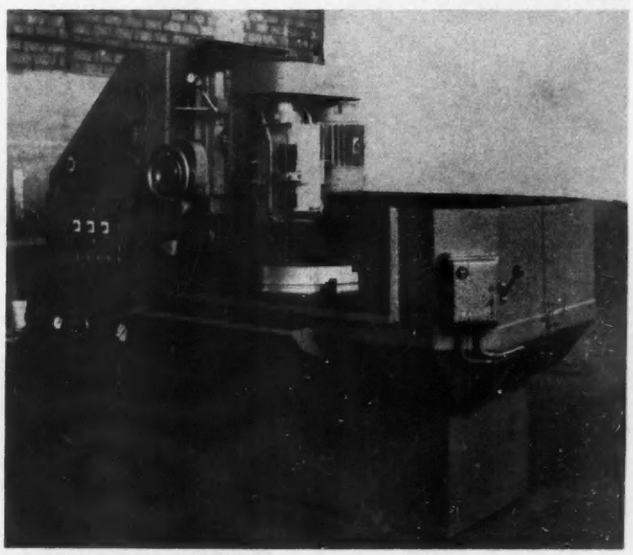
Rotary Table Surface Grinder

We have received particulars of the "PSM" rotary table surface grinding machine made by Karl Mengele and Söhne, Günzburg/Donau, German Federal Republic, and handled in the United Kingdom by Stuart Davis, Ltd., Much Park Street, Coventry. The grinder is built in two sizes, the models "PSM 900" and "PSM1200" with table diameters of 900mm and 1200mm respectively. The machines, of which we illustrate the first, have been specially designed for grinding the abutting faces of casings and similar narrow surfaces, but can be used equally for the surface grinding of larger solid or interrupted surfaces, as well as for simultaneously surfacing a number of smaller components held in a jig. According to the maker's statement, the machines are specially heavily built for the size of motor used (10/13 h.p. or 15/20 h.p. with a grinding disc diameter of 348mm in both cases). On the other hand, the mode of operation allows cuts to be taken which are always, except at corners, at small angles to the length of the workpiece, so that vibrations are less readily set up. The machine can thus be of lighter construction than usual and at the same time take heavier cuts.

In order to cover a large workpiece by taking cuts in the manner described, the grinder is arranged to carry out a rotating movement of the table combined with a reciprocating movement, thus producing a pattern or figure. This also avoids the occurrence of zero feed speed at the centre of the rotating table which otherwise easily leads to an overheating of the workpiece.

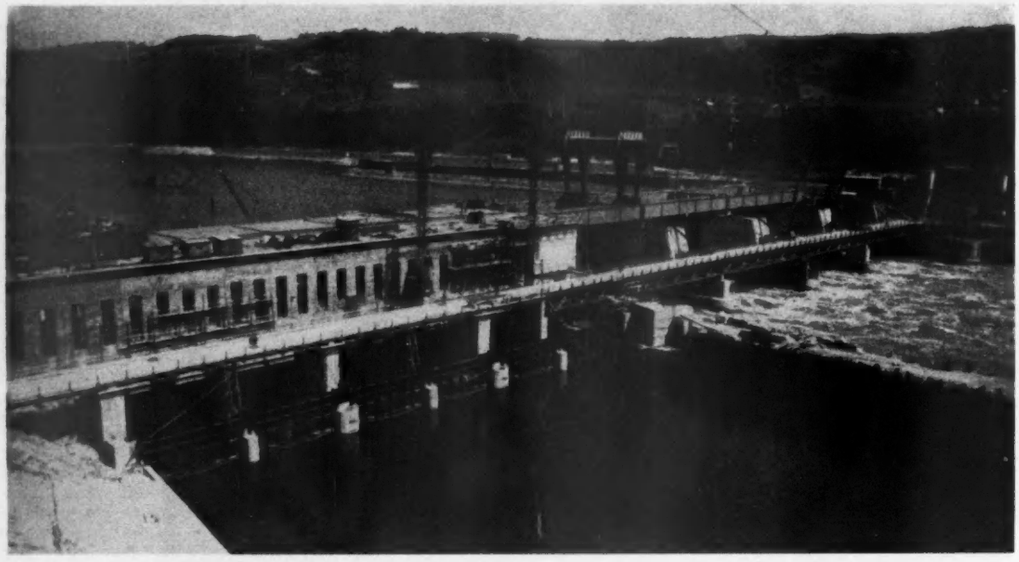
The table movements are electro-hydraulically controlled by cams, and feeds are infinitely variable; either movement can be used by itself without the other. The carriage is fitted with precision roller bearings in order to eliminate stick-slip vibrations.

The vertical headstock slide feeds down in such a manner that the grinding disc, which is of the segmental kind, is always in contact with the work. The wheel is fed down either by hand, or automatically by pre-selected steps, one step at every other reversal of the carriage. A fast headstock movement is available e.g. when the wheel is to be retracted for dressing. The wheel wear and amount of dressing is obtained by a micrometer and transferred to the dial indicator which is used for measuring the total cut taken. In this way the effect of change in dimension of the wheel is eliminated. Double column versions of these machines are also available.

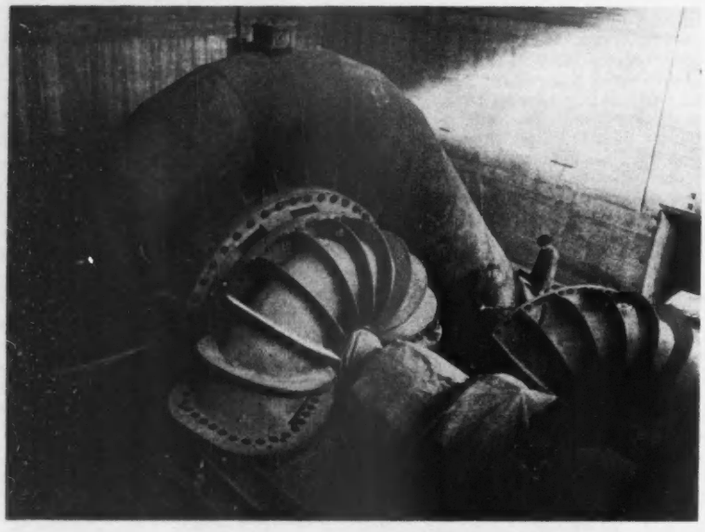


Rotary table surface grinder, model "PSM 900"

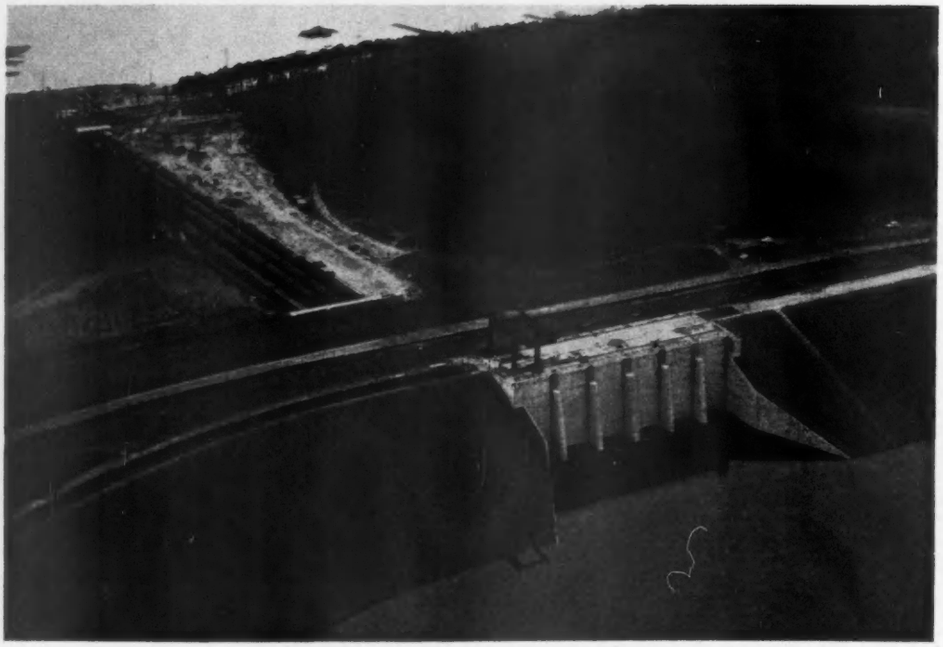
Continental Water Power



The Danube station of Ybbs-Persenbeug is designed to generate eventually 1252 million kWh in the mean year, 43·2 per cent of it in the winter, by means of six 31·5 MW Kaplan sets. The locks were put into service on December 1, 1956, and May 14, 1957. They have a capacity of 40,000,000 tons annually, or ten times the present traffic. Two of the main turbines of the South power house (right) were recently commissioned



On December 20, the first 35MW set of Geesthacht power station, near Hamburg, went into service. Two further sets are to follow in the spring of this year. A description of this important scheme will be found on page 543 of our issue of April 5 last. It comprises a 3·3 million cubic metres artificial storage reservoir on the Geestrücken hills north of the River Elbe and 35km east of Hamburg. Here, up to 580,000kWh of pumped storage has become available to supply peaks in the area of Hamburg, which until then obtained its electricity from 700MW of thermal plant. The construction of the reservoir (below) involved an earth movement of 2,250,000 cubic metres, of which 2,000,000 were moved between March and September, 1956. Waterproofing is by a 7cm thick layer of bitumen-sand and a 6-7cm top layer of asphalt. Because of the low head of water between the reservoir and the Elbe, which varies between 70m and 85m, economic power production could only be obtained by keeping capital costs to a minimum and they are expected to be of the order of DM.600 per kW



In the final plant there will be six 35MW sets each consisting of a 32-43·5MW horizontal Francis turbine laid out for 51-60 cumecs and 214 r.p.m., and a 43·75MVA generator. Four to six of them will be pumping sets, with the generators as motors driving a single-stage pump delivering 33 cumecs each. One of these pumps is shown above in process of installation. The scheme was made possible by the damming up of the river by about 3·5m in order to facilitate navigation. Damming-up had become necessary as dredging work in the area of the port of Hamburg had caused erosion further upstream and a lowering of the water level at low tide

The American Scene

BY OUR AMERICAN EDITOR

Atomic Depression

As 1957 came to its close, it became increasingly evident that the firms which build and equip atomic reactors in the United States are in the midst of what might be called a commercial fall-out. All over the once-mushrooming industry, companies these days are dismantling staffs, laying off workers and letting blueprints for expansion gather non-radioactive dust. In October, the U.S. Atomic Energy Commission cancelled its contracts for the construction of the Elk River and Wolverine Electric nuclear power projects. Furthermore, the A.E.C. announced that it had " suspended activities directed toward the design and construction of the Food Irradiation Reactor and will terminate its contract with Kaiser Engineers for development work on this project." A firm as prominent as the Foster Wheeler Corporation was reported to have decided to drop its power reactor business, liquidate its nuclear division and concentrate on the fabrication of heavy components only. Several concerns which supply such facilities with fuel elements have reduced the size of their staffs. In November Mr. Morehead Patterson, head of the American Machine and Foundry Company, a pioneer and leader in the field, summed up the current disenchantment. In the future, said Mr. Patterson, his firm would move " gingerly." " We don't expect to make any money out of research reactors," he added. " We will be lucky not to lose some." Harnessing the atom, in short, has proved anything but profitable, either for private enterprise or for the United States as a whole. For this surprising fizzle, a number of reasons may be cited.

To begin with, nuclear power, as something new under the sun, has tested industry's technological mettle ; to package and market this new source of energy has been neither cheap nor easy. At the same time, its vast promise attracted a great many people into the field ; far too many, indeed, for the amount of business either on hand or in prospect. The trouble, however, springs less from technology or competition than from government regulation. Like its military counterpart, peacetime fission on the whole remains chained to a federal bureaucracy, which willy-nilly and—despite heavy outlays of public funds—tends to stifle progress and raise costs. Thus, to step up the flow of subsidies, as many in and outside of Washington are urging, would be folly. The solution lies not in more money but in fewer controls.

In 1954, to be sure, after nearly a decade of federal monopoly, atomic power was opened up to private industry. The latter, however, was given only limited freedom, subject to the sweeping authority of the Atomic Energy Commission. By law, for example, nobody may do nuclear work without first winning clearance from the A.E.C. The agency, moreover, is the only source of fissile material ; hence in practice, if not in theory, it wields complete control over the design and specifications of all American atomic power stations. The A.E.C. has a carrot as well as a stick at its command. It may supply industry with fissile fuel free of charge, if it chooses, or make generous grants for research and development. Now, apparently, with widespread encouragement from the trade, the Commission is mulling over a large-scale expansion of financial assistance, extending to reactors built for sale abroad. Such a programme undoubtedly would please the domestic manufacturers of nuclear " hardware." In the words of Mr. Lewis L. Strauss, the Chairman of the A.E.C., it also might give " new, concrete evidence of our faith in the concept of worldwide Atoms for Peace." However, many Americans feel that by any measure it would do more harm than good. First, to judge by existing subsidies, it would be very costly. For example, according to one unfriendly estimate, the large reactor at Shippingport, which became critical last month will exact from the American taxpayer nearly 25,000,000 dollars per year. The original investment of the A.E.C. in others—notably the project under construction for a public power group in Nebraska—will run to perhaps twice as much. In view of the growing demand for atomic energy overseas, where it is competitive with that generated by fossil fuels, the financial burden could increase alarmingly. Moreover, to subsidise the export of American reactors would be tantamount to dumping on the world market. The United States, after all, is by no means the only source of supply. On the contrary, in Great Britain are manufacturers who stand ready and willing to compete and have already done so most successfully. In such a contest, both parties have their selling points. The British manufacturers, having frozen their models, undoubtedly can offer a cheaper plant, and one which consumes natural uranium, rather than the enriched variety obtainable only in the U.S. American firms, on the other hand, sooner or later well might come up with a superior design.

Whatever the immediate outcome, healthy rivalry of this kind could only serve as a spur to technological advance. It also undoubtedly would encourage the lowering of costs, a realm in which the Commission perhaps has been most remiss. Only lately, indeed, has it grown obvious that nuclear power, under A.E.C. regulation, is high-cost power indeed. Thus, the Consolidated Edison Company of New York now figures that the cost of its Indian Point reactor, put originally at 235 dollars per kilowatt, may run as high as 325 dollars per kilowatt. Other power companies have made similar unpleasant discoveries. For such high costs, as one leading nuclear authority has observed, the A.E.C. itself is partly to blame. Specifically, he has charged that American manufacturers are burdened by an undue need to maintain security (" We cannot afford to pay for a host of guards indefinitely"), unrealistic specifications on parts and equipment, and an excessive price for nuclear fuel. In his view, the most compelling need confronting the industry could be summed up by the words ; " Fission those costs ! " Far from furthering so sensible a purpose, federal subsidies, whether for domestic or foreign reactors, plainly would impede it.

In the realm of security practice, even the celebrated case of Dr. Robert Oppenheimer arose from the past recently to pose some haunting second thoughts in Washington, like a guilty conscience. It is not Dr. Oppenheimer himself who is particularly troublesome. Rather it is the era that he symbolised—an era when a popular mistrust was built up concerning scientists and intellectual " eggheads " in general, when the late Senator McCarthy was commandeering his way through Army laboratories looking for Communist engineers and when many foreign scientists were not permitted into the United States for fear of political contamination. The haunting second thoughts are that in this troublesome era America may have sacrificed scientific knowledge and advancement for the sake of security over that already known. As Dr. James R. Killian, now scientific adviser to the President, observed some three and a half years ago at a time when the Oppenheimer case was a major issue on the national scene : " A condition has been created in which there sometimes seems to be a preoccupation with security procedures and policies at the expense of scientific progress."

What is really called for, then, is less governmental control, not more. In discarding the ill-conceived McMahon Act, the United States three years ago took a small step in this direction. Now, as all the foregoing suggests, it is time to take a giant step. Wherever possible, consistent with the national safety, Washington should get out of the nuclear power business. The country wants—and one day may have great need of—a flourishing reactor industry. Like any other, however, that industry cannot thrive by leaning on a government crutch. It can thrive only by overcoming its difficulties through its own efforts.

Completion of Pressurised Water Reactor at Shippingport, Pennsylvania

WHAT is considered to be the world's first full-scale atomic power station devoted exclusively to civilian purposes became critical at Shippingport, Pennsylvania, on December 2. Incidentally, that date marked the fifteenth anniversary of the achievement of self-sustaining nuclear fission in the world's first reactor at Chicago, designed and built under the supervision of the late Enrico Fermi.

The Westinghouse Electric Corporation designed and constructed the nuclear portions of the plant under contract with the U.S. Atomic Energy Commission. The Duquesne Light Company contributed 5,000,000 dollars toward the nuclear portion of the plant, constructed, at its expense, the turbo-generator portion, and will operate the entire station for the Atomic Energy Commission. During the initial starting test, the reactor operated at a power level of about 25kW of heat. No electricity was generated. In the course of the next several weeks numerous tests will be made to determine the nuclear characteristics of the reactor and to establish the satisfactory operation of all reactor components. Following these tests, the power level of the reactor will be increased gradually. At full power, the reactor plant will produce 60MW of electricity which will flow into the grid system of the Duquesne Light Company.

National Metal Congress and Exposition

No. I

THE Thirty-ninth National Metal Congress and Exposition was held in Chicago, Illinois, from November 4 to 8. As in previous years, it was sponsored by the American Society for Metals, the Institute of Metals Division of the American Institute of Mining, Metallurgical and Petroleum Engineers, and the Society for Non-Destructive Testing. Some 500 companies engaged in either the production, treatment or fabrication of metals, gave displays and demonstrations of their products or services at the exhibition, which was held at the Chicago International Amphitheatre. Over the years, the Metal Show has continued to become ever broader in its coverage of the metals and metal working field, and gone are the days when it was concerned mainly with the heat-treatment of steels. This year there was again a strong accent on the fabrication and application of some of the more recently developed metals, such as titanium, zirconium, columbium and tantalum. Among the trends to be noticed at the Metal Show were an increasing variety of radiography equipment using radioactive isotopes and particle accelerators as sources of energy ; greater uses of ultrasonic techniques in the fields of non-destructive testing, metal cleaning and metal joining ; an accent on " automation " applied to a variety of metal processing plant ; and a growing popularity of vacuum melting furnaces and other vacuum processing equipment.

World Metallurgical Congress

This year's National Metal Congress had a particularly international aspect, since it was held in conjunction with the Second World Metallurgical Congress, which was organised with great success by the American Society for Metals, under the directorship of Dr. Zay Jeffries. The congress followed a similar one held in Detroit in 1951, and had a total attendance of over 500 from forty-two foreign countries, including eighty conferees from the United Kingdom. The purpose of the congress was : (1) To share scientific knowledge and technical and business " know-how " by planned works inspections, and informal discussion. (2) To interchange technical and scientific knowledge about metals and metallurgy. (3) To participate in meetings at scientific levels in the metals industry at the National Metal Congress and Exposition. (4) To confer, discuss and exchange latest information, knowledge and techniques in respective fields of metal fabrication. (5) To counsel and discuss conservation, utilisation and substitution for strategic metals. (6) To cement friendship and good-will by business and social gatherings in the various American cities that were visited in guided tours.

The conferees met in New York City in mid-October and were formally entertained at a " Welcome to America " luncheon at the Waldorf-Astoria Hotel on October 21. Each delegate indicated in advance a choice of one of nine groups according to his predominant interest. Each of these groups was scheduled to proceed on a guided tour for two weeks, during which important works institutions and operations were visited and local conferences held. On arrival in Chicago on November 2, the last eight days of each tour were spent at the National Metal Congress and Exposition and sessions of the Second World Metallurgical Congress convening in Chicago. The nine groups established by the organisers of the Congress were as follows : (1) steelmaking and refining ; (2) non-ferrous refining and fabrication ; (3) ferrous fabrication (machining, forming, finishing) ; (4) heat-treatment ; (5) welding and joining ; (6) inspection and testing ; (7) management problems in the metals industry (this group was eventually consolidated with others) ; (8) education and research (private industry, government bureaux, educational institutions and foundations, and research institutes) ; (9) metallurgical aspects of atomic energy.

An indication of the comprehensive programme of works visits may be obtained from the following brief review of the group (2) tour of non-ferrous refining and fabrication plants. The members of the tour went to the U.S. Metals Refining Company, at Carteret, New Jersey, visiting the copper smelting and refining furnaces, anode department tank house, scrap plant, oxygen-free high-conductivity copper division and aluminium division. Then followed a visit to the American Smelting and Refining Company, at Perth Amboy, New Jersey, observing the copper refinery, lead refinery and the continuous casting plant for the production of bronze rods, tubes and shapes. On the following day, the group visited the Superior Tube Company at Norristown, Pennsylvania. With its sister company, Pacific Tube Company, in Los Angeles, California, it produces cold-drawn ferrous and non-ferrous tubing to precise dimensions, surface finishes and mechanical properties. Sizes range from 0·1mm to approximately 15mm outside diameter, and thicknesses from as little as 0·05mm up to 3mm. The company also produces many different kinds of cathode sleeves, disc cathodes, anodes and other vacuum valve parts, made mostly from highly specialised nickel-base alloys.

After travel to the Pittsburgh area, the group went to the Aluminum Company of America at New Kensington, Pennsylvania, where they inspected the research laboratory. In Cleveland there was a visit to the Chase Brass and Copper Company, which is well known for its complete and modern facilities for the fabrication of copper and brass rod, sheet and tube products from raw material to finished goods. The operations here included casting, hot working by piercing, extrusion and rolling, with subsequent cold working operations to finished products. Another visit in Cleveland was to the Apex Smelting Company, whose works are devoted entirely to the manufacture of aluminium smelters' ingot for use in foundries and die casting plants. Aluminium scrap is blended with aluminium ingot and alloying elements to make casting ingot to exact specifications. At Toledo, Ohio, the group visited the new Chevrolet plant of the General Motors Corporation, which produces automatic transmissions for the Chevrolet automobile and forgings, die castings and machined parts. The next visit was to the Doehler-Jarvis Division of the National Lead Company. The two factories of this concern are equipped with die casting machines for the production of aluminium and zinc parts for the automotive, household appliance, office equipment, electrical, aircraft and hardware industries. At one of the works a large die casting machine is capable of producing in one piece an aluminium automobile engine block and other large aluminium die castings weighing up to 75 lb.

Following travel to Detroit, Michigan, the conferees visited the Metallurgical Products Department (Formerly Carboloy Department) of the General Electric Company. Here powdered tungsten, carbon, cobalt, titanium, tantalum, &c., are combined through powder metallurgy techniques to produce cemented carbides. Conferees observed the quality control methods employed in the processing. Metallic powders are ball milled, pressed, sintered and machined to end up as cutting tools for cutting metals, rock drilling and coal mining. Also observed were techniques used in producing carbide dies. Induction vacuum melting furnaces for producing high-temperature alloys were also seen in full operation. In the afternoon the group visited the Climax Molybdenum Company of Michigan. This research laboratory is the main metallurgical and chemical research organisation for the parent company. Equipment and testing facilities, machine shops, chemical laboratories, X-ray and metallography equipment were inspected. This works is also the site of pilot plant operations for the production of vacuum-melted, high-purity molybdenum and alloy ingots, 9in in diameter, weighing up to ½ ton. On the following day, there was a visit to Brooks and Perkins, of Detroit, where the delegates observed the hot drawing of magnesium and titanium sheet, stretch forming, Guerin process rubber forming, anodising of magnesium by the HAE process, and the welding, riveting, sawing, drilling, routing, sanding and organic finishing of assemblies. Also visited was the firm's magnesium rolling mill, where magnesium alloys are made, cast into rolling slabs, and rolled into sheet and plate. " Boral " for neutron shielding is also made at the rolling mill. Following this visit the group travelled to Chicago.

The group visited the Reynolds Metals Company, at McCook, Illinois. Here aluminium pig and scrap are melted and cast into rolling ingots, after alloying. The rolling ingots are homogenised, scalped and rolled into sheet and plate. The finished sheet and plate is slit into coils. If heat-treatable, the sheet is stretched, finished and sheared to dimension. The mill has a monthly capacity of 30,000,000 lb of finished sheet and plate. The final visit of this group was to the Hawthorne Works of the Western Electric Company in Chicago. The visitors saw the copper rod and wire mill hot rolling of copper wire bars and the cold drawing of rod into wire. They also toured the works making and testing communication cable, the foundry producing grey iron sand castings and aluminium die castings ; the metals mill melting and rolling strip brass, bronze, nickel silver and " Permalloy," and the relay and wired equipment works manufacturing telecommunications equipment with " automated " assembly lines.

In Chicago, the foreign delegates were formally welcomed at a reception on November 3, followed by the opening plenary session, in the ballroom of the Palmer House Hotel, which was entitled " Metals of Tomorrow." The speakers at this session included John Reedman, acting director of the United Nations Organisation's Bureau of Economic Affairs, New York City, discussing " Mineral and Energy Resources of the Free World." " The Role of the Metal Engineer in Nuclear Power " was the subject of R. A. Skinner, of the John Thompson Nuclear Energy Company, Ltd. Other speakers were E. C. Wright, head of the Metallurgy Department of the University of Alabama ; Francis C. Frary, of the Aluminum Company of America, and Dr. Otto Schaaber, director of a German technical institute at Bremen.

The World Metallurgical Congress came to its conclusion on November 8, when the delegates were entertained to a " Farewell to America " banquet at the Palmer House Hotel. On this occasion, the gold medal of the Congress was awarded to Dr. Zay Jeffries, the director-general of the second W.M.C., and the silver medal of the Congress to both Kingsley W. Given, the assistant to the director-general, and to Donald S. Clark, the president of the American Society for Metals. In bidding the conferees farewell, William H. Eisenman, executive secretary of the A.S.M., announced that a third World Metallurgical Congress is to be held in Chicago in November, 1962, and expressed the hope that many of the foreign visitors may have an opportunity of once again coming to the United States at that time.

Westinghouse Electric Corporation

An important development in the field of magnetic materials was demonstrated at the stand of the Westinghouse Electric Corporation, of Pittsburgh, Pennsylvania. It is a cube-oriented silicon-iron alloy termed " Cubex," which will operate at higher flux densities and, at the same time, have decreased energy losses. It is well known that to obtain maximum quality of any soft magnetic alloy, four factors must be considered : (1) control of impurities ; (2) reduction of internal stresses ; (3) control of crystal size, and (4) control of crystal orientation. Of these four, crystal orientation has been the most difficult to accomplish and major research effort has been concentrated in this field. At the start of this investigation, it was decided that an alloy

of 3 per cent silicon-iron would be the basic composition to be studied. This alloy has a saturation magnetisation close to that of pure iron, a high resistivity, one crystal structure up to the melting point, and is a basically cheap raw material. Three per cent silicon-iron has a cubic crystal structure with three mutually perpendicular directions of magnetisation. If a magnetic field is applied parallel to any of these directions, minimum energy is required to magnetise the sample.

Considering the three kinds of magnetic materials—random, singly-oriented and cube-oriented—the following properties are obtained. The random material may be likened to a bag of blocks that has been thoroughly shaken. This is the kind of structure associated with hot-rolled silicon steel sheets. With this random array of cubes, it is obvious that the applied magnetic field cannot be oriented in such a way that it is always parallel to a cube face. Singly-oriented steel consists of cubes standing on edge, and hence, is often called " cube on edge orientation." The easy direction of magnetisation lies only along one direction of the sheet, and lines representing the other cube axis would extend out of the top and bottom of the sheet at 45 deg. angles. The double, or cube orientation, may be thought of as a tray of ice cubes. Then the easy directions of magnetisation are parallel to the length, width and height of the strip, as shown in Fig. 1.

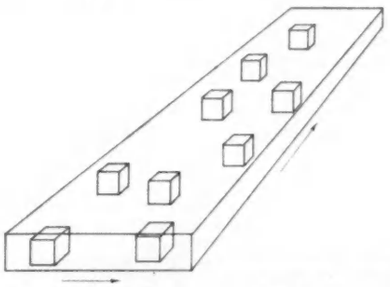
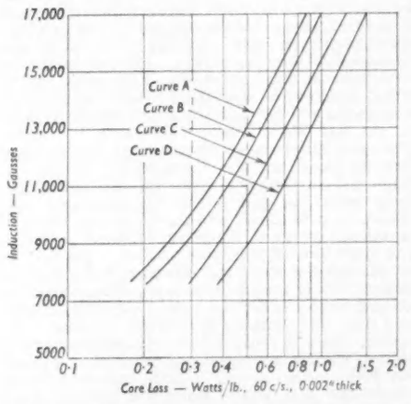


Fig. 1—Arrangement of cubes in doubly oriented silicon steel developed by Westinghouse

The main advantage of the new cube-oriented alloy is that the magnetic flux can now turn corners easily. This is shown in the following table by comparing some magnetic properties of cube-oriented material with singly-oriented material in rectangular punchings.

The loss curves reproduced in Fig. 2 show that the new material is considerably better than the

Induction (Gausses)	Singly-oriented magnetising force (Oersteds)	Cube-oriented magnetising force (Oersteds)
2,500	0·50	0·15
5,000	0·64	0·20
7,500	0·83	0·33
10,000	1·20	0·55
12,000	2·45	1·00
14,000	10·75	1·75
Coercive force (Oersteds)	0·40	0·175



Curve *A* : cube oriented, average of straight and cross grain.
Curve *B* : singly oriented, straight grain only.
Curve *C* : singly oriented, average of straight and cross grain.
Curve *D* : singly oriented, cross grain only.

Fig. 2—Graph of core loss/induction for materials of different grain orientation

corresponding singly-oriented strip. The data was obtained from the same heat process to give both the singly and cube-oriented alloy. Tests were run on standard 30cm long strips cut parallel and perpendicular to the length of the sheet.

The value of crystal orientation has long been recognised by Westinghouse in the design of transformers. But in the past each design was based on singly-oriented material and fabrication techniques took every possible advantage of the one easy direction of magnetisation. The spiral " C " core design winds the singly-oriented material in a coil, while the shell form construction takes punchings from the material and arranges the strips at right angles to each other. In generator stator core assemblies, if maximum use is to be made of singly-oriented material, then it would be necessary to punch the teeth in one direction, the wide curved section in another direction, and weld the two together. A single punching from the new cube-oriented material could satisfy this two-direction orientation requirement. This cube orientation is not the usual configuration found in iron and, therefore, special metallurgical processes had to be found in order to accomplish the desired result.

The formation of this cube orientation depends on what is believed to be a new mechanism of crystal growth and on carefully controlled structure during the metallurgical processing. For this reason, a considerable amount of research and development is still required before this new material will be commercially available in all useful sizes. Experiments in the laboratory have already shown that the alloy can be made in thicknesses currently being used in 60 c/s electrical apparatus, and the Westinghouse Materials Engineering Magnetics Laboratory and Materials Manufacturing Department at Blairsville, Pennsylvania, have produced small amounts in thicknesses useful for high-frequency applications. Laboratory quantities of the material have also been made from conventionally melted ingots produced at a steel mill. Under the best conditions, test strips have been made that approach 100 per cent orientation with regard to the cube plane and the easy magnetisation directions of the cube are all within 20 deg. of the rolling direction or 90 deg. to it.

The first public demonstration of the new Levitation Melting Apparatus also took place at the Westinghouse stand. Levitation melting is a versatile method for the small-scale preparation of molten metals, whereby a metal is heated to melting temperature while suspended freely in space. A charge, usually a compact of metal powder or chips, is placed inside a coil which carries high-frequency alternating current. Eddy currents, induced by the fluctuating electromagnetic field, cause the metal to melt. At the same time the action of the field on the metal causes it to float within the coil, as shown in Fig. 4. Because the process uses no containing vessel for the metal and is carried out in an inert atmosphere, it permits high-purity preparation of metals and alloys that are difficult to prepare with equal purity by conventional methods. Melting by levitation is accomplished in a matter of seconds, and a vigorous stirring action of the electromagnetic field ensures intimate mixing of the melt. The technique has proved valuable in the preparation of specimens for mechanical testing, metallographic examination, hardness measurement, X-ray diffraction and magnetic studies.

The high-frequency, small-ingot levitation technique is now in routine use in the Metallurgy Department of the Westinghouse Research Laboratories. Several dozen different metals and alloys, usually in 8 to 12 gramme quantities, have been prepared. In addition to those mentioned above, these have included such metals as copper, silver, silicon, zirconium, chromium, molybdenum, niobium, and many alloys of these and other metals. The coil voltage employed depends upon the size and nature of the metal charge, and is usually in the range of 500V to 900V at 450 kc/s. Atmospheres of argon, helium, hydrogen and mixtures of ammonia with argon have been used. Melting almost invariably occurs in less than one minute. Often the metals remain suspended in space, not only in the molten state, but with hundreds of degrees of superheat.

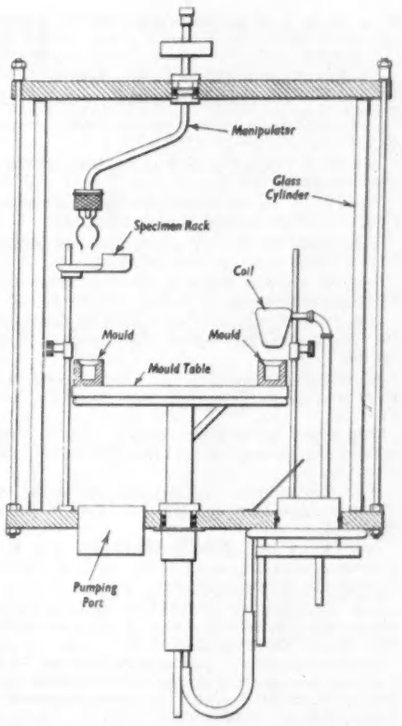


Fig. 3—Cut-away view of levitation melting chamber

A sectional view of the melting chamber is shown in Fig. 3. In using the levitation melting apparatus, the chamber is sealed, evacuated and filled to atmospheric pressure with the protective atmosphere. A prepared charge of metal is removed from the specimen rack and placed within the coil by means of a small manipulator. The coil voltage is raised rapidly, causing the charge to rise inside the coil and float just below

Fig. 4—Westinghouse levitation melting apparatus causing metal sample in the coil to melt and to float freely in space

the top turn of the coil. With the rotating mould table, as many as fifteen specimens can be melted successively without opening the chamber.

Castings in the shape of flat plates, rods, tensile specimens and the like, can be prepared. The ingots are characterised by unusual homogeneity and, in the case of simple ingots, little or no shrinkage cavity. The levitation melting technique has been used at the Westinghouse Research Laboratories for the sintering of compacts of refractories and for holding metals in an atmosphere to study the solubility of the gas in the molten metal.

(*To be continued*)

Personal and Business

Appointments

CAPTAIN J. A. CREED has been appointed a director of Robert Boby, Ltd.

MR. A. H. HIRD, M.I.Mech.E., has been appointed a director of Vickers, Ltd.

MR. W. A. C. MCINTYRE has been appointed a director of Reed Brothers (Engineering), Ltd.

MR. ERIC WILSON has been appointed general sales manager of Camp Bird Industries, Ltd.

MR. W. HUCKER has been appointed group publicity manager for the Lancashire Dynamo Group.

MR. G. R. CURRY has been appointed director of the Locomotive and Allied Manufacturers' Association.

SAMUEL OSBORN AND CO., Ltd., has announced that Mr. A. V. Tiddy has been appointed local director.

THE RIGHT HONOURABLE ANTONY HEAD has been appointed a director of Associated Electrical Industries, Ltd.

MR. CHRISTOPHER COLLARO and Mr. A. W. M. HARTLEY have been appointed directors of Camp Bird, Ltd.

Mr. R. J. W. RUDKIN, M.I.N.A., has been appointed general manager Naval Yard, of Vickers-Armstrongs (Shipbuilders), Ltd.

MR. H. DESMOND CARTER has been appointed chairman of Crossley Brothers, Ltd., in succession to the late Sir Kenneth I. Crossley, Bt.

LONDON TRANSPORT has announced that Mr. W. E. G. Hewings, secretary of the executive works committee of London Transport, has been promoted to principal executive assistant.

MR. DAVID JOHN GUILD has been appointed to the Midlands area as technical representative of Armstrong Whitworth (Metal Industries), Ltd., and Jarrow Metal Industries, Ltd.

A.E.I. LAMP AND LIGHTING COMPANY, Ltd., has announced the appointment of Mr. H. G. Lilley to the post of manager, lighting department, in succession to Mr. C. W. M. Phillips, who has resigned.

THE ROYAL SOCIETY announces that Sir William Penney, Sir Lindor Brown, Sir Charles Dodds and Sir Bryan Matthews have been appointed vice-presidents for the year ending November 30, 1958.

BRITISH OXYGEN GASES, Ltd., has announced that Mr. J. L. Harrison has been appointed technical sales manager, and Mr. K. T. Brightman, assistant technical sales manager, of Davy British Oxygen, Ltd.

MR. F. C. WRIGHT has been appointed managing director of Standard Telephones and Cables, Ltd., in succession to Sir Thomas Spencer. Sir Thomas continues as chairman of the company and its subsidiaries.

BROOK MOTORS, Ltd., has announced the transfer of Mr. W. Ford, sales engineer at its Swansea sales office, to its sales office in Birmingham. Mr. Ford will replace Mr. H. C. Curtis, who has left the company.

MR. A. E. ROE has been appointed secretary of Almin, Ltd., in succession to Mr. W. Brining, who has relinquished his appointment. Mr. Brining continues as a director of Almin, Ltd., and of its subsidiary companies.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., has announced that Mr. A. F. Miller has been appointed branch manager of the Aberdeen branch office, and Mr. L. R. Cleworth, branch manager of the Newcastle branch office.

CROFTS ENGINEERS (HOLDINGS), Ltd., has announced that Mr. John Midgley has been appointed managing director of its subsidiary company, Carter Gears, Ltd., in succession to Mr. Maurice Carter. Mr. Carter remains a director.

DAVY AND UNITED ENGINEERING COMPANY, Ltd., has announced the appointment of Mr. M. F. Dowding, M.I.Mech.E., as chief engineer. Mr. A. A. Thomas, A.M.I.Mech.E., has been appointed engineering sales manager in succession to Mr. Dowding.

MR. CORNELIS VFROLME, president of Verolme United Shipyards, has been awarded the Order of the Lion of Finland, Knight First Class, in recognition of his special efforts and co-operation extended to Finland during the post-war years in the rebuilding of the Finnish merchant fleet.

THE UNITED STEEL COMPANIES, Ltd., announces the following appointments :—Mr. K. G. Lampson, Lieut.-Colonel P. F. Benton Jones, Lieut.-Commander G. W. Wells and Mr. R. J. Bavister have been appointed directors of Samuel Fox. Mr. K. G. Lampson, Lieut.-Colonel P. F. Benton Jones and Mr. I. M. Kemp have been appointed directors of Appleby-Frodingham, and Mr. R. P. Crawshaw has been appointed a director of United Steel Structural Company, Ltd.

THE ENGLISH ELECTRIC COMPANY, Ltd., announces the following appointments :—Mr. K. Druce, A.M.I.E.E., has been appointed manager of the Bristol office, responsible for the South-West of England territory, in succession to Mr. T. Robinson, who has retired. Mr. H. Granville-Brown, A.I.E.E., has taken charge of the Southampton office following the retirement of Mr. I. Mackintosh. The Southampton office has been moved to 29, Shirley Road, Southampton (telephone, Southampton 28333).

JOHNSON AND PHILLIPS, Ltd., announces the following appointments :—Mr. R. L. Stanley, A.M.I.E.E., has been appointed transformer sales engineer for the home market, and has been succeeded as manager at the Glasgow branch by Mr. D. W. Gregory, A.M.I.E.E. Mr. J. T. Easter has been appointed Edinburgh branch manager. Mr. E. F. Ward has been appointed manager of the contract department in succession to Mr. L. H. Burton, who has retired after forty-four years in the service of the company. Mr. J. Bentley, A.M.I.E.E., has been appointed chief engineer, construction, in the contract department.

THE CENTRAL ELECTRICITY GENERATING BOARD announces the following appointments :—Mr. D. P. Sayers, M.I.Mech.E., M.I.E.E., chief commercial and operations engineer of the Board ; Mr. E. S. Booth, M.I.Mech.E., M.I.E.E., chief design and construction engineer of the Board ; Mr. J. L. Ashworth, A.M.I.Mech.E., A.M.I.E.E., deputy regional director of the North West, Merseyside and North Wales Region ; Mr. W. H. Dunkley, M.I.Mech.E., M.I.E.E., controller of the South Eastern Division ; Mr. A. R. Clague, A.M.I.Mech.E., A.M.I.E.E., controller of the South Western Division ; Mr. F. W. Skelcher, M.I.Mech.E., M.I.E.E., controller of the Midlands Division ; Mr. W. Wilde, A.M.I.Mech.E., A.M.I.E.E., controller of the South Wales Division ; Mr. C. G. Richards, A.M.I.Mech.E., A.M.I.E.E., controller of the Yorkshire Division, and Mr. B. C. Pyle, M.I.E.E., chief assistant project engineer to the Northern Project Office.

Business Announcements

CAPTAIN W. H. S. HALL, marine superintendent of Bullard, King and Co., Ltd., has retired.

MR. FRANK RABONE, group development executive, Turriff Construction, has transferred his office to the company's headquarters at Warwick.

MR. T. WORSNOP, engineering department manager of Ransomes and Rapier, Ltd., has retired after forty-three years' service with the company.

KAYSER, ELLISON AND CO., Ltd., states that it is opening in February a new warehouse at Station Road, Coleshill (telephone, Coleshill 2041/2).

MR. CHARLES F. CLEAVER, M.I.C.E., M.I.Mech.E., M.I.Loco.E., has retired from the boards of directors of A.C.V. Sales, Ltd., and British United Traction, Ltd.

MR. J. R. CAMPBELL, F.R.I.C.S., has established an office at 17A, Market Street, Nottingham, and will practise as building surveyor, municipal consultant, town planner and highway engineer.

HARRIS ENGINEERING COMPANY, Ltd., announces that its offices at Harrow have been transferred to Universal House, Lincoln Way, Lincoln Road, Enfield, Middlesex (telephone, Howard 4881–2).

THE PULSOMETER ENGINEERING COMPANY, Ltd., states that the address of the London office of the Pulsometer Group is now Pulsometer House, 20–26, Lamb's Conduit Street, W.C.1 (telephone, Holborn 1402).

THE JOHN BULL GROUP OF COMPANIES states that it has acquired part of the John Richardson factory, Evington Valley Road, Leicester, which will be used principally by its subsidiary, C.P. Engineering Company, Ltd.

MR. SPENCE SANDERS has retired from the board of directors of Almin, Ltd., and has also relinquished his directorships of other companies in the group. He will continue with the group in the capacity of group consultant.

HENRY RIGHTON AND CO., Ltd., has been appointed official stockholder of non-ferrous metals for Imperial Chemical Industries, Ltd., Metals Division, and henceforth all materials supplied will be exclusively of I.C.I. manufacture.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., states that it has acquired the whole of the issued share capital of Colliery Explosives Company, Ltd., Newton-le-Willows, Lancs. The new subsidiary will be administered by the Nobel Division of I.C.I.

PERMALI, Ltd., states that the address of its London office is now 39, Victoria Street, S.W.1 (telephone, Abbey 6494). This address is also the London office of the associated companies, Hordern Richmond, Ltd., and Hydulignum-Jabroc (Tools), Ltd.

EXPANDITE, Ltd., announces that Mr. J. M. Robb, manager of the overseas division, will leave this country on January 13 for a tour of Scandinavia. Mr. A. J. Orbell, overseas technical representative, will leave this country on January 22 to visit distributors in Germany.

CRAVEN BROTHERS (MANCHESTER), Ltd., Stockport, has announced that its office in Scotland has been transferred to 157, West George Street, Glasgow, C.2 (telephone, City 5285). Mr. H. Probert has succeeded Mr. G. H. Buchanan as representative in Scotland and also has charge of the new office.

Contracts

THE BRITISH TRANSPORT COMMISSION has placed a contract with the Birmingham Railway Carriage and Wagon Company, Ltd., Smethwick, for forty-five main line diesel-electric locomotives of 1550 h.p. each, for use on the Kent Coast lines of the Southern Region of British Railways. The locomotives will be used mainly for hauling freight traffic, and for inter-regional passenger services which cannot be operated by electric multiple-unit trains or electric locomotives. The new diesel-electric locomotives, which will have a BB wheel arrangement and be classified as type 3, will have Sulzer diesel engines (manufactured in Britain by Vickers-Armstrongs, Ltd.) and Crompton Parkinson electrical equipment.

Miscellanea

"CRITICAL REVIEW OF NUCLEAR POWER PROGRESS."—An unfortunate slip in the printing of our article under the above title (January 3) distorted the meaning of a sentence on page 9, at the opening of the last paragraph in the first column. The word *not* appeared in place of the word *now*. The sentence should have read : "It is now clear that the idea of classifying types of reactors as falling into Stage 1, Stage 2 or Stage 3 for the power programme has been dropped."

VACUUM OVEN.—We are informed by Griffin and George, Ltd., Ealing Road, Alperton, Wembley, Middlesex, that it is about to produce in quantity the "Gardiner precision vacuum oven." This was developed in the Tate and Lyle research laboratories during investigation of the drying of labile substances, and is now thought to be suitable where loss of weight on heating has to be determined exactly and reproducibly. "The sample," says the maker's announcement, "is taken into solution and distributed over an aluminium powder extender contained in a sample dish." It is then heated under partial vacuum while a current of dried air or inert gas (water content less than 0·0007 mg. per litre) is bled over its surface : the drying train for the bleed consists of three glass U-tubes filled with activated alumina and a glass tube filled with barium oxide. The gas passes through exit ducts in the lid via a control spigot into a metal desiccator screwed into the underside of the heating block. A thermostat with a bimetallic sensor, said to be adjustable to 110 deg. Cent. ± 1 deg. Cent., a thermometer (0 deg. to 110 deg. Cent.), and a soap-film flow meter (0·5 to 100 ml per minute), and a vacuum pump connector are fitted. There are twelve refractory heating elements and places for six shallow 2in diameter sample dishes. The oven can be switched to 70W or 160W.

DRY COOLING TOWERS.—A cooling system which makes it possible to site power stations where large volumes of cooling water are not available or can only be provided at excessive cost is being developed by The English Electric Company, Ltd. (Negotiations for the design and construction of a commercial-scale installation were announced recently by the Central Electricity Authority : see THE ENGINEER, December 20, 1957, page 908.) The plant uses a system proposed by Professor L. Heller, of Budapest University, and Mr. L. Forgö, in a paper delivered at the last World Power Conference in Vienna. The essential features are the injection of pure water into the steam and the cooling of the mixture of water and condensate by air in large heat exchangers fitted round the base of the cooling tower. The system is to be closed and the circulating water of condensate purity ; the plant should therefore be free from internal corrosion troubles. The flow of air through the cooler is produced by either induced draught fans or natural draught, the choice depending on such factors as fuel cost, atmospheric temperature and size. Two factors contribute to economy : the cooler, which is made entirely of aluminium and is simple, effective and cheap, and the spray condenser, which eliminates the drop in temperature between the condensate and cooling water that occurs in the conventional condenser. The English Electric Company's studies indicate that as soon as cooling water becomes a special problem for any reason, the new scheme will quite frequently be more economical than the normal.

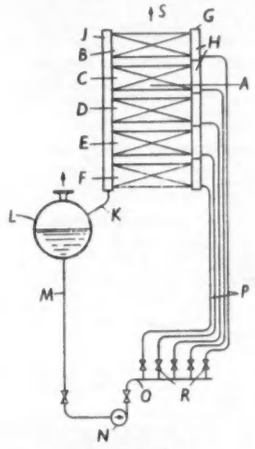
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

STEAM GENERATORS

786,412. June 20, 1956.—FORCED RECIRCULATION STEAM BOILERS HEATED BY WASTE GASES, Heinrich Vorkauf, personally responsible partner of La Mont Kessel Herpen and Co., Hannover-Herrenhausen, Loepentinstrasse 3, Germany.

The invention relates to forced recirculation steam boilers and it has for its object an improved arrangement for isolating and controlling the water flow to groups of tubular elements. The drawing illustrates diagrammatically a circular waste heat boiler *A* with

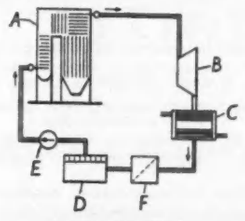


No. 786,412

tube groups *B*, *C*, *D*, *E* and *F*, and distributor header *G* divided into compartments *H* corresponding to the number of tube groups. The tubular elements, which emanate from the compartments *H* of the distributor header, are connected at their other end to the common collector header *J*, which is connected by pipe *K* to the steam and water drum *L*. The boiler water is drawn from the drum *L* through pipe *M* by the circulating pump *N*, and discharges through delivery pipe *O* to the individual pipelines *P*, which connect to the compartments *H* in the distributor header. The isolating valves *R* at the beginning of the pipelines *P* are positioned for easy operation from the circulating pump control platform. By closing valves *R* the individual tube groups can be isolated and steam output can be regulated in accordance with demand. Gases flow through the boiler in direction of arrow *S*. A square type waste heat boiler is also shown in the specification.—*November* 20, 1957.

787,103. November 7, 1955.—SALTS DEPOSITS IN THE TUBE SYSTEMS OF STEAM GENERATORS, Sulzer Freres, Societe Anonyme, Winterthur, Switzerland.

The invention relates to a method of reducing troublesome effects of salts deposits in the tube systems of steam generators which normally operate at or above the critical point of the working medium. The invention as applied to a steam power plant is shown in the drawing. In this plant working medium flows in a circuit from a steam generator *A* through a turbine *B* and a condenser *C* into a feed water tank *D* which contains feed water purified by ion exchange.



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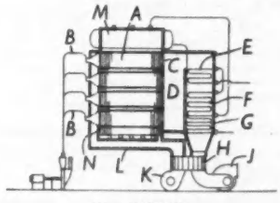
From the feed water tank *D* the water is passed back by a pump *E* into the steam generator. Between the condenser *C* and the feed water tank *D* there is provided a cation exchanger *F* in which salts which have penetrated into the condensate, usually mainly in the condenser, are rendered harmless by exchanging the sodium ions of these salts predominantly for potassium ions. If the salts content of the condensate is too high, a total salts removing plant could be provided between the condenser *C* and the cation exchanger *F*. In the cation exchanger *F* no regard need be paid to the temperature of the condensate, which is generally about 35 deg. to 40 deg. Cent., since the cation exchange masses usually employed can generally withstand temperatures up to 110 deg. Cent. without damage. In contrast to this, the exchange masses usually employed for anion exchange can withstand temperatures only up to about 35 deg. Cent. without damage. The regeneration of the cation exchange mass used in the invention is effected by means of potassium compound or compounds, of which the neutral salts such as potassium chloride or potassium sulphate are preferred. Cation exchange masses regenerated with potassium compounds have the effect that more than 50 per cent of the sodium ions still present in the feed water already purified, for instance, by a total salts removal process, are replaced by potassium ions. The sodium salts residues that unavoidably still remain in the feed water are thus no longer so great that their possible deposition in the tube system of the steam generator would cause troublesome effects of the magnitude that would be experienced were the invention not employed.—*December* 4, 1957.

787,280. June 16, 1955.—STEAM BOILER PLANTS, A/B Svenska Maskinverken, Södertälje, Sweden.

The invention provides the possibility of attaining a uniform steam temperature over a great range of steam load, without employing a superheater of a size necessitating subsequent cooling means for the superheated steam at higher loads. Referring to the drawing, *A* are combustion chambers arranged in two groups each with four chambers vertically one above the other. The chambers *A* are cylindrical with horizontal axes. *B* are ducts for the supply of fuel such as pulverised coal, which is introduced at one end of each chamber. At the opposite end there is a central outlet opening *C* to a common flue gas channel *D*. The gas flowing through the channel *D* first passes through a superheater divided into two



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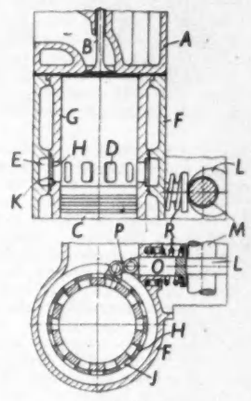
parts *E* and *F*, thereafter through an economiser *G* and, finally, via an air preheater *H*, to a fan *J*, from where it is conveyed to the chimney. Combustion air is supplied by a fan *K* and passes the air preheater *H* before flowing into a casing *L* which surrounds the chambers. The plant has a steam drum *M* which is common to all the chambers. Downcomers extend from the steam drum to headers below the lowermost chambers and from these headers tubes *N* lining the chambers extend to give a continuous communication from the lower part of the group to the steam drum. During operation the capacity of the plant can be controlled by connecting or disconnecting one or more chambers, the disconnection being preferably carried out from above downwards in each group. For this control there are provided shutting-off and/or control devices for fuel as well as for combustion air for each chamber, the devices being individually operable. The casing *L* is preferably heat-insulating, and each chamber can be made as a separate insulated unit. From this it is obvious that when one or more of the upper chambers of a group is or are shut off, there will be no unnecessary loss of heat due to the heat insulation, and as the chambers taken out of operation are kept heated, it is easier to restart them. —*December* 4, 1957.

INTERNAL COMBUSTION ENGINES

786,969. February 16, 1955.—FOUR-STROKE ENGINES, Lanova A.G., of 16, Bahnhofstrasse, Zurich, 1, Switzerland.

The invention relates to a four-stroke internal combustion engine having a shortened compression stroke, particularly to one in which the exhaust is controlled by valves in the cylinder head and the intake by piston-controlled ports in the cylinder wall in the zone of the bottom dead centre position at the end of the suction stroke. As shown in the drawing, the cylinder head *A* has one exhaust valve *B*, which is controlled in a four-stroke cycle in known manner. Above the bottom dead centre position of the piston *C* inlet ports *D*, which lead into an annular passage *E* in the cylinder jacket *F* are provided in the wall of the cylinder liner *G*. An annular slide *H*, which has apertures *J* corresponding to the inlet ports *D*, is disposed in the annular passage in a groove *K* in the cylinder liner. A cam *L* on a shaft *M* running at half the speed of the crankshaft controls the annular slide *H*. The cam acts on a tappet *O*. The tappet *O* is pivotally connected to the annular slide *H* by means of a link *P*. A helical spring *R* between



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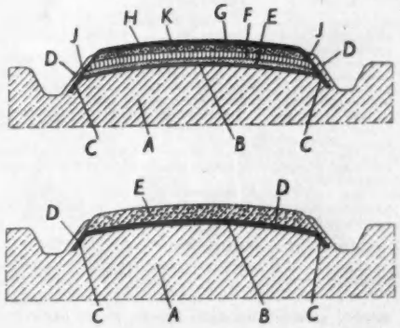
the cylinder jacket *F* and the tappet head *N* tends to hold the annular slide in the closed position. The control of the annular sleeve *H* is so designed that it opens the ports *D* in the cylinder liner *G* within the interval in which the piston *C* uncovers the ports *D* during the end of the suction stroke and the beginning of the compression stroke. As a result the compression stroke is reduced by the height of the inlet ports *D*. A smaller reduction of the compression stroke may be obtained by an earlier closure of the ports by the slide. According to a further feature of the invention, the shaft *M* may be provided with a second cam so positioned that the slide *H* opens the ports *D* for a short time at the beginning of the exhaust stroke. In this way fresh air is drawn into the cylinder by the inertia of the exhaust gases rushing out through the exhaust valve. This air forms an air cushion in front of the piston crown and thus all combustion products are removed.—*November* 27, 1957.

ROAD CONSTRUCTION

787,303. January 24, 1956.—STREETS PROTECTED FROM FROST, Algemeene Kunstvezel Maatschappij Naamlooze Venootschap, 261, Benoordenhoutseweg, The Hague, Holland.

An object of the invention is to provide a road construction not requiring considerable removal of earth, whilst at the same time enabling a road insensitive to frost occurring in our latitudes to be produced. The drawing shows two examples of roads protected against frost. The upper view shows a road having a bituminous surface, and the lower view a concrete road. In the road shown in the



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upper view a layer of glass fibres *B* has been placed on the natural earth *A*. Other layers of glass fibre *C* are placed within the slopes *D*. On the layer of fibres *B* there is a layer of mortar *E* in which the blocks *F* are set. The blocks are covered in the usual way with a layer of stone *G* on which there is a waterproof layer *H*. This layer extends at *J* over the layers of fibre *C*. Layer *H*, in turn, supports the usual road surface *K* composed of fragments and bitumen. In the concrete road shown in the lower view a layer of fibre *B* likewise rests on the soil *A* and if necessary there is an identical layer of fibre *C* in each slope. Layers *B* and *C* are directly covered with a layer of fibre *D* impregnated with bitumen, which itself directly carries the structure of concrete *E*.—*December* 4, 1957.

Launches and Trial Trips

PORT VALE, trawler; built by The Goole Shipbuilding and Repairing Company, Ltd., for The Consolidated Fisheries, Ltd.; length between perpendiculars 137ft, breadth 28ft, depth 14ft 3in, trial speed 12¾ knots; Mirrlees KSSD.M.8 diesel engine, 1000 b.h.p. at 600 r.p.m.—Trial, October 21.

BANBURY CROSS, tug; built by Philip and Son, Ltd., for the Tees Towing Company, Ltd.; length overall 82ft, breadth moulded 23ft 6in, depth moulded 8ft 6in; Crossley CGL4–32 diesel engine, 750 b.h.p. at 320 r.p.m., Voith Schneider propeller.—Launch, October 22.

BRITISH ARCHITECT, oil tanker; built at Wallsend by Swan, Hunter and Wigham Richardson, Ltd., for B.P. Tanker Company, Ltd.; length between perpendiculars 640ft, breadth moulded 86ft, depth moulded 49ft 3in, deadweight 34,500 tons on 37ft draught, service speed 15½ knots; thirty cargo oil tanks, one main cargo pump room, three 850 tons per hour turbine-driven cargo oil pumps, two stripping pumps; two 600kW, 440V, a.c. turbine-driven alternators, one 150kW diesel-driven alternator and one 75kW steam-driven alternator; one set of Wallsend Slipway double reduction geared compound turbines, 15,500 maximum shaft horsepower at 108 propeller revolutions per minute, two Babcock and Wilcox "Selectable Superheat" boilers supply steam at 600 lb per square inch and 850 deg. Fah.—Launch, October 23.

SCOTTISH PTARMIGAN, oil tanker; built by John Brown and Co. (Clydebank), Ltd., for the British and Commonwealth Shipping Company, Ltd.; length between perpendiculars 530ft, breadth moulded 72ft, depth 39ft, deadweight 18,000 tons; nine centre and sixteen wing tanks; service speed 13½ knots; two 150kW diesel-driven generators, one 75kW steam-driven generator; Doxford oil engine, six cylinders, 670mm diameter by 2320mm combined stroke, 6400 b.h.p.—Launch, October 24.

OKLAHOMA-GETTY, oil tanker; built by the Ateliers et Chantiers de France for the Hemisphere Transportation Corporation; length overall 785ft 7½in, length between perpendiculars 747ft 11in, breadth moulded 102ft 0½in, depth 51ft 8in, load draught 38ft 6in, deadweight 51,850 tons, displacement 67,100 tons; thirty-six cargo oil tanks, four 1130 tons per hour turbine-driven cargo pumps; two 650kW, 450V, turbo-generators, one 75kW diesel-driven generator; one set of C.E.M.-Parsons double reduction geared turbines, 19,000 maximum shaft horsepower, steam supplied at 600 lb per square inch and 850 deg. Fah. by two Foster-Wheeler boilers.—Trial, October.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

Mon., Jan. 13.—CENTRAL LONDON BRANCH: White Hall Hotel, Bloomsbury Square, London, W.C.1, "Diesel Engines as applied to Electrical Practice," H. A. Gill, 6.30 p.m.
Tues., Jan. 14.—PORTSMOUTH BRANCH: Wiltshire Lamb Hotel, Portsmouth, "Nuclear Generation," A. L. Shaw, 7.30 p.m. ★ YORK BRANCH: Royal Station Hotel, York, "Electronic Instruments," Messrs. Perkins and Smith, 7.30 p.m.
Wed., Jan. 15.—GLASGOW BRANCH: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "Portable Electric Tools," A. R. Graydon, 8 p.m.
Thurs., Jan. 16.—S.W. LONDON BRANCH: Visit to the Post Office Cable and Wire Service, Electra House, Victoria Embankment, London, W.C.2, 5.30 p.m.
Sat., Jan. 18.—OXFORD, READING AND DISTRICTS BRANCH: Clarendon Laboratory, Oxford, "Research at the Clarendon Laboratory," 7 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Mon., Jan. 13.—MIDLAND REGION: Exchange and Engineering Centre, Birmingham, "Atomic Energy," W. R. Wootton, 11 a.m.; Film, "Combustion," 2.30 p.m.

DIESEL ENGINEERS AND USERS ASSOCIATION

Thurs., Jan. 16.—Caxton Hall, Westminster, London, S.W.1, "Development and Maintenance of Marine Diesel Engines," A. G. Arnold, 2.30 p.m.

ILLUMINATING ENGINEERING SOCIETY

Tues., Jan. 14.—LONDON CENTRE: Federation of British Industries, 21, Tothill Street, London, S.W.1, "Lighting of Aircraft Flight Decks," J. W. Strange and B. Stevens, 6 p.m.
Thurs., Jan. 16.—MANCHESTER CENTRE: N.W. Electricity Board, Town Hall, Manchester, 2, "The Use of Coloured Light," H. Hewitt, 5.30 p.m.

INCORPORATED PLANT ENGINEERS

Mon., Jan. 13.—DUNDEE BRANCH: Mathers Hotel, Dundee, "Planned Maintenance," A. J. MacIntyre, 7.30 p.m.
Tues., Jan. 14.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "Plastics in Industry," 7.15 p.m.
Wed., Jan. 15.—KENT BRANCH: Kings Head Hotel, High Street, Rochester, "Some Notes on Boiler Inspection and Insurance," 7 p.m.
Thurs., Jan. 16.—BLACKBURN BRANCH: Lecture Hall, Blackburn, "Fuel and Power Policy," Gerald Nabarro, 7.30 p.m.
Fri., Jan. 17.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, "Fuel Injection," T. G. Charlesworth, 7.30 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., Jan. 15.—SOUTHAMPTON SECTION: Technical College, St. Mary's Street, Southampton, Technical Films, "The Story of Steel," 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Mon., Jan. 13.—S. WALES SECTION: S. Wales Institute of Engineers, Park Place, Cardiff, Annual General Meeting, 6 p.m. ★ STUDENT LECTURE: Memorial Building, 76, Mark Lane, London, E.C.3, "Modern Marine Steam Turbines," J. H. Gooch, 6.30 p.m.
Tues., Jan. 14.—SOUTHERN JOINT BRANCH: Technical College, St. Mary Street, Southampton, "Hull Surveys and where to look for Defects," H. Mackechnie, 7.30 p.m.
Thurs., Jan. 16.—KINGSTON UPON HULL AND E. MIDLANDS SECTION: Royal Station Hotel, Kingston upon Hull, "Recent Developments in British Naval Main Propulsion Steam Turbines," the late F. J. Cowlin and A. F. Veitch, 7.30 p.m. ★ N.E. COAST SECTION: Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne, "Heat Balance Calculations and their use in the Installation Design of Steam Turbine Merchant Ship Propulsion Machinery," E. Tyrrell, 6.15 p.m.

INSTITUTE OF METALS

Tues., Jan. 14.—S. WALES LOCAL SECTION: University College, Singleton Park, Swansea, "Electron Microscopy," J. W. Menter, 6.30 p.m.
Wed., Jan. 15.—17, Belgrave Square, London, S.W.1, "The Mechanism of Clustering and Precipitation in Metals," David Turnbull, 6.30 p.m.

INSTITUTE OF NAVIGATION

Fri., Jan. 17.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, "The Influence of Atmospheric Conditions on Radar Performance," J. R. Saxton, 5.15 p.m.

INSTITUTE OF PHYSICS

To-day, Jan. 10.—MANCHESTER AND DISTRICT BRANCH: Bragg Lecture Theatre, The University, Manchester, "Contact Electrification," P. S. H. Henry, 6.45 p.m.
Wed., Jan. 15.—LONDON AND HOME COUNTIES BRANCH: 47, Belgrave Square, London, S.W.1, "Physical Research in the Research Group of the Atomic Energy Authority," B. F. J. Schonland, 6 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

To-day, Jan. 10.—WESTERN CENTRE: Rougement Hotel, Exeter, "Road Transport Law," 7 p.m. ★ SOUTH WALES CENTRE: South Wales Institute of Engineers, Park Place, Cardiff, "Some Considerations Affecting the Selection and Use of Fuels and Lubricants for Road Transport," C. G. Tressider, 7 p.m.
Tues., Jan. 14.—MIDLANDS CENTRE: Exchange and Engineering Centre, Stephenson Place, Birmingham, "The Free Piston Gasifyer, with special reference to Vehicle Applications," 7.30 p.m.
Wed., Jan. 15.—E. MIDLANDS CENTRE: Mechanics' Institute, Nottingham, "Some Considerations Affecting the Selection and Use of Fuels and Lubricants for Road Transport," C. G. Tressider, 7.30 p.m.
Thurs., Jan. 16.—METROPOLITAN AREA: Royal Society of Arts, John Adam Street, London, W.C.2, "The Work of the Motor Industry Research Association," A. Fogg, 6.30 p.m. ★ YORKSHIRE CENTRE: North British Hotel, Edinburgh, "Some Considerations Affecting the Selection and Use of Fuels and Lubricants for Road Transport," C. G. Tressider, 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., Jan. 14.—Great George Street, Westminster, London, S.W.1, "Lake Nyasa and the River Shire," N. J. Cochrane, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Jan. 13.—LONDON SECTION: Savoy Place, London, W.C.2, Discussion on "The Use of Electricity in the Garden by Amateurs," opened by M. M. Harvey, 5.30 p.m. ★ NORTHERN IRELAND CENTRE: Sir William Whitla Hall, Queen's University, Belfast, Joint Meeting with Northern Ireland Branches of Institution of Civil Engineers and Institution of Mechanical Engineers, "Engineering Education in the Soviet Union," P. E. Sleight and E. Giffen, 7.30 p.m. ★ NORTH STAFFORDSHIRE SUB-CENTRE: Technical College, Stafford, "Mechanical Strength of Power Transformers in Service," E. T. Norris, 7 p.m. ★ WESTERN CENTRE: University Engineering Laboratories, Bristol, "The B.B.C. Sound Broadcasting Service on Very High Frequencies," E. W. Hayes and H. Page, 6 p.m.
Tues., Jan. 14.—N.E. CENTRE: College of Further Education, Workington, "Earthing of Low and Medium-Voltage Distribution Systems and Equipment," 7 p.m. ★ N.W. UTILIZATION GROUP: Engineers' Club, Albert Square, Manchester, "Recent Developments in Low-Voltage High-Rupturing-Capacity Fuse Links," R. H. Dean, 6.15 p.m. ★ LONDON GRADUATE AND STUDENT SECTION: 3 (Tels) Training Bn., R.E.M.E., Arborfield, Berks, "Transistor Amplifier Circuits," W. A. Thorpe, 7 p.m.
Wed., Jan. 15.—RUGBY SUB-CENTRE: Temple Speech Room, Rugby, "The Electrification of the British Railways," G. H. Fletcher, 7.30 p.m. ★ SOUTHERN CENTRE: Technical College, Brighton, "The B.B.C. Sound Broadcasting Service on Very-High Frequencies," E. W. Hayes and H. Page, 6.30 p.m.
Thurs., Jan. 16.—UTILIZATION SECTION: Savoy Place, London, W.C.2, "Recent Developments in Low-Voltage High-Rupturing-Capacity Fuse Links," R. H. Dean, 5.30 p.m. ★ N. MIDLAND CENTRE: Yorkshire Electricity Board, Ferensway, Hull, Chairman's Address, A. J. Coveney, 6.30 p.m.

INSTITUTION OF ENGINEERING DESIGNERS

Mon., Jan. 13.—Northern Architectural Association Hall, 6, Higham Place, Newcastle upon Tyne, "Shielded Arc Welding," W. A. Woolcott, 7.15 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

Tues., Jan. 14.—39, Elmbank Crescent, Glasgow, "Craneage in Works and Shipyards," D. L. Nicolson, 6.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS

Wed., Jan. 15.—Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1, "Experience with the Steel Fire Boxes of the Southern Region 'Pacific' Locomotives," M. G. Burrows and A. L. Wallace, 5.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Jan. 10.—1, Birdcage Walk, Westminster, London, S.W.1, General Meeting in conjunction with the Internal Combustion Engineering Group, "Design and Development of Four Lightweight High-Speed Marine Gas Turbines for Electric Generator Drive," A. W. Pope, and "Developments in Methods of Measuring Stresses in Compressor and Turbine Blades on Test Bed and in Flight," D. A. Drew, 6 p.m.
Tues., Jan. 14.—EASTERN BRANCH: Great White Horse Hotel, Ipswich, Annual General Meeting, "The American System of Education and Training of Mechanical Engineers," H. S. Arms, 7.30 p.m. ★ AUTOMOBILE DIVISION: 1, Birdcage Walk, Westminster, London, S.W.1, "The Prevention of Corrosion in Car Bodies," T. P. Hoar, 6 p.m.
Wed., Jan. 15.—SOUTHERN BRANCH: Royal Star Hotel, Maidstone, Annual General Meeting, Chairman's Address, 7.30 p.m. ★ N.E., A.D., CENTRE: The University, Leeds, "Some Experiments with Internal Combustion Engines," R. C. Cross, 7.30 p.m. ★ N.E. GRADUATES' SECTION: Vane Arms Hotel, Stockton, "Nylon and its Uses," W. E. Humphreys, 7 p.m. ★ SOUTHERN GRADUATES' SECTION: Technical College, Southampton, "Transmissions for Small Marine Craft," K. W. Roberts, 7.30 p.m.
Thurs., Jan. 16.—INDUSTRIAL ADMINISTRATION AND ENGINEERING PRODUCTION GROUP: 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on "Export Packing of Engineering Products," 6.45 p.m. ★ MIDLAND BRANCH: James Watt Memorial Institute, Birmingham, Annual General Meeting, "Outlook for Oil," H. E. Willoughby, 6 p.m. ★ N.W. BRANCH: Engineers' Club, Albert Square, Manchester, Annual General Meeting, "Rotary Shaft Seals: The Sealing Mechanism of Synthetic Rubber Seals Running at Atmospheric Pressure," E. T. Jagger, 6.45 p.m. ★ SCOTTISH BRANCH: Royal College of Science and Technology, Glasgow: "Hydraulic Transmissions for Railway Application," R. H. Fett and H. M. Dannatt, 7.30 p.m. ★ YORKSHIRE BRANCH: Hotel Metropole, Leeds, Annual General Meeting, 6.30 p.m. ★ E. MIDLANDS GRADUATES' SECTION: Technical College, Avenue Road, Grantham, "Power from Nuclear Energy," M. D. Wood, 7.15 p.m. ★ N.E. GRADUATES' SECTION: Rutherford Technical College, Northumberland Road, Newcastle upon Tyne, "Bearings and Bearing Failure," W. N. Mills, 7 p.m.
Fri., Jan. 17.—GENERAL MEETING, THOMAS LOWE GRAY LECTURE: 1, Birdcage Walk, Westminster, London, S.W.1, "Machinery for Cross-Channel Passenger Ships," E. L. Denny, 6 p.m.

INSTITUTION OF MINING AND METALLURGY

Thurs., Jan. 16.—Geological Society, Burlington House, Piccadilly, London, W.1, "Microradiographic Study of the Action of Flotation Reagents," I. N. Plaksin; "The Training of Mining Engineers," A. W. S. Schumann, 5 p.m.

INSTITUTION OF NAVAL ARCHITECTS

Tues., Jan. 14.—SOUTHERN JOINT BRANCH: Technical College, St. Mary Street, Southampton, "Hull Surveys and where to Look for Defects," H. Mackechnie, 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

To-day, Jan. 10.—EASTERN REGION: Golden Lion Hotel, Cornhill, Ipswich, "Defining a New Era—Information, Control, Cybernetics and Electronics," E. R. Davies, 7.30 p.m.
Mon., Jan. 13.—LEEDS SECTION: Hotel Metropole, King Street, Leeds, 1, "Correct Application of Electrical Equipment to Production Machinery," W. L. Sims, 7 p.m. ★ SHEFFIELD SECTION: Grand Hotel, Sheffield, "Unit Transfer Machine Applications," C. D. Camwell, 6.30 p.m.
Tues., Jan. 14.—DONCASTER SECTION: Danum Hotel, Doncaster, "Air in the Service of Man," 7.15 p.m. ★ PETERBOROUGH SECTION: White Lion Hotel, Church Street, Peterborough, "Cost Reduction by Production Planning and Control," R. J. Smithson, 7.30 p.m.
Wed., Jan. 15.—BIRMINGHAM LOCAL SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Inter-Process Mechanisms for Press Work," J. P. Udall, 7 p.m. ★ PRESTON SECTION: College of Further Education, Sandy Lane, Accrington, "Modern Copy Turning Technique," 7.30 p.m. ★ SOUTHAMPTON SECTION: Town Hall, Christchurch, "International Geophysical Year," R. de Atkinson, 7.15 p.m. ★ S. ESSEX SECTION: Mid-Essex Technical College, Chelmsford, "Office Mechanisation," E. S. Carden, 7.30 p.m.
Thurs., Jan. 16.—SOUTHAMPTON SECTION: Polygon Hotel, Southampton, "Automobile Accessory Production," Mr. Lusted, 7.15 p.m. ★ LONDON SECTION: Royal Empire Society, Northumberland Avenue, London, W.C.1, "A New Approach to Production Control," J. L. Burbidge, 7 p.m. ★ CORNWALL SECTION: School of Mines, Camborne, Cornwall, "The Role of Metallurgist in Production Engineering," Hugh Bartle, 7.15 p.m.
Fri., Jan. 17.—SWANSEA SECTION: Central Library, Alexandra Road, Swansea, "Mechanical Aid to Inspection," L. Hare, 7.30 p.m.

INSTITUTION OF PUBLIC HEALTH ENGINEERS

Thurs., Jan. 16.—Caxton Hall, Westminster, London, S.W.1, "Smoke Free Incineration of Liquid Wastes and Sludges," R. F. West, 6 p.m.

INSTITUTION OF THE RUBBER INDUSTRY

Tues., Jan. 14.—LONDON SECTION: Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, London, W.1, "New Synthetic in Cables," W. S. Penn, 7 p.m.; "Modern Testing Methods and Equipment," F. N. B. Bennett, 5.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Wed., Jan. 15.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institution, Middlesbrough, "Water Towers," J. O. C. Ritchie, 6.30 p.m. ★ WALES AND MONMOUTHSHIRE BRANCH: Mackworth Hotel, Swansea, "Some Notes on the Use of High Pre-Load Bolts in the United Kingdom," E. M. Lewis, 6.30 p.m. ★ YORKSHIRE BRANCH: Central Electricity Authority, Whitehall Road, Leeds, "An Introduction to Prestressed Concrete in Highway Engineering," D. Beckett and B. J. S. Walls, 6.30 p.m.
Fri., Jan. 17.—S.W. COUNTIES BRANCH: Duke of Cornwall Hotel, Plymouth, "Lifting Equipment," W. R. Hockaday, 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS

Mon., Jan. 13.—SHEFFIELD AND DISTRICT SECTION: Livesey Clegg House, 44, Union Street, Sheffield, 1, "Chemical Engineering: Chemical Pumps," Ian N. Merrill, 7.30 p.m.
Fri., Jan. 17.—Pepys House, 14, Rochester Row, London, S.W.1, "Journal Bearings in Theory and Practice," F. T. Barwell, 7 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

Fri., Jan. 17.—Engineers' Club, Albert Square, Manchester, "Corrosion in Action," R. Butcher, 6.45 p.m.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, Jan. 10.—Lecture Theatre, Mining Institute, Newcastle upon Tyne, "University Education in Marine Engineering," G. H. Chambers, 6.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION

Tues., Jan. 14.—B.I.S.R.A., Hoyle Street, Sheffield, Annual General Meeting of the Refractories Group and Address by Chairman, A. H. B. Cross, 7 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Wed., Jan. 15.—CORROSION GROUP: 14, Belgrave Square, London, S.W.1, "Stress Corrosion Cracking," T. P. Hoar and J. G. Hines, 6.30 p.m.
Thurs., Jan. 16.—ROAD AND BUILDING MATERIALS GROUP: 14, Belgrave Square, London, S.W.1, "Problems in the Introduction of New Materials to the Building Industry," F. L. Brady, 6 p.m.

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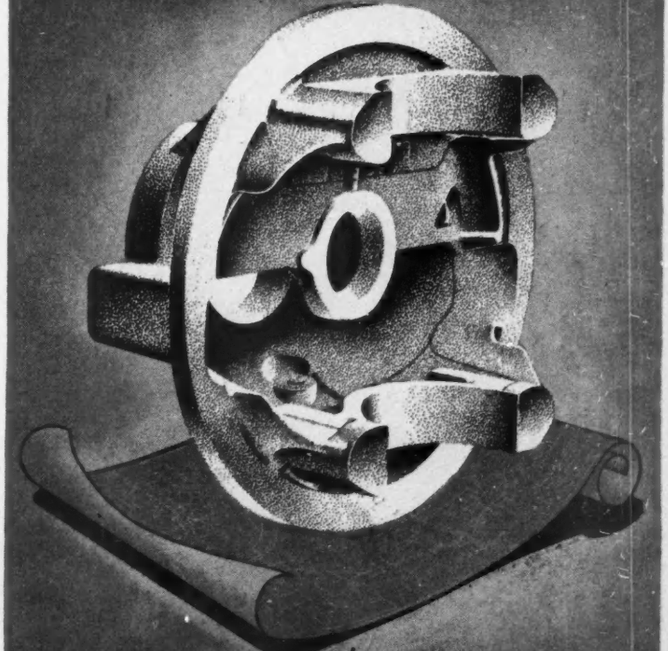

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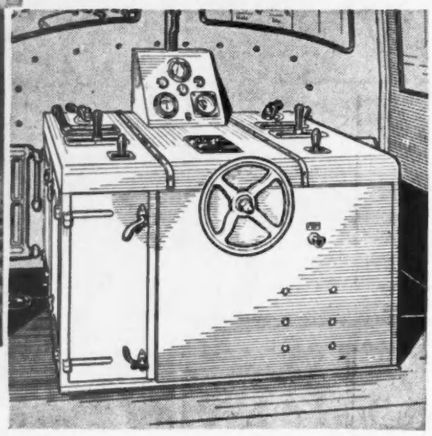

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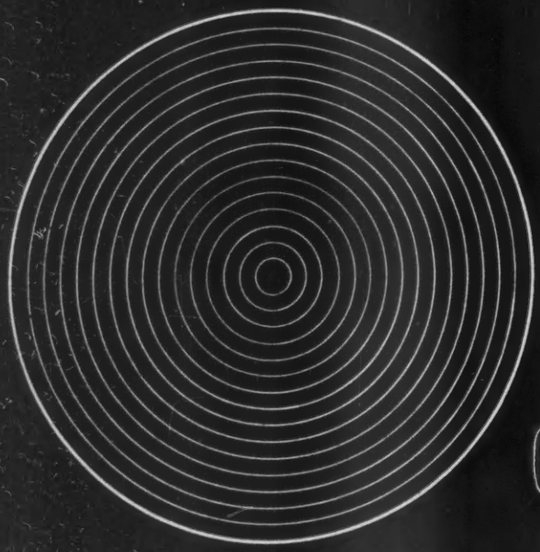

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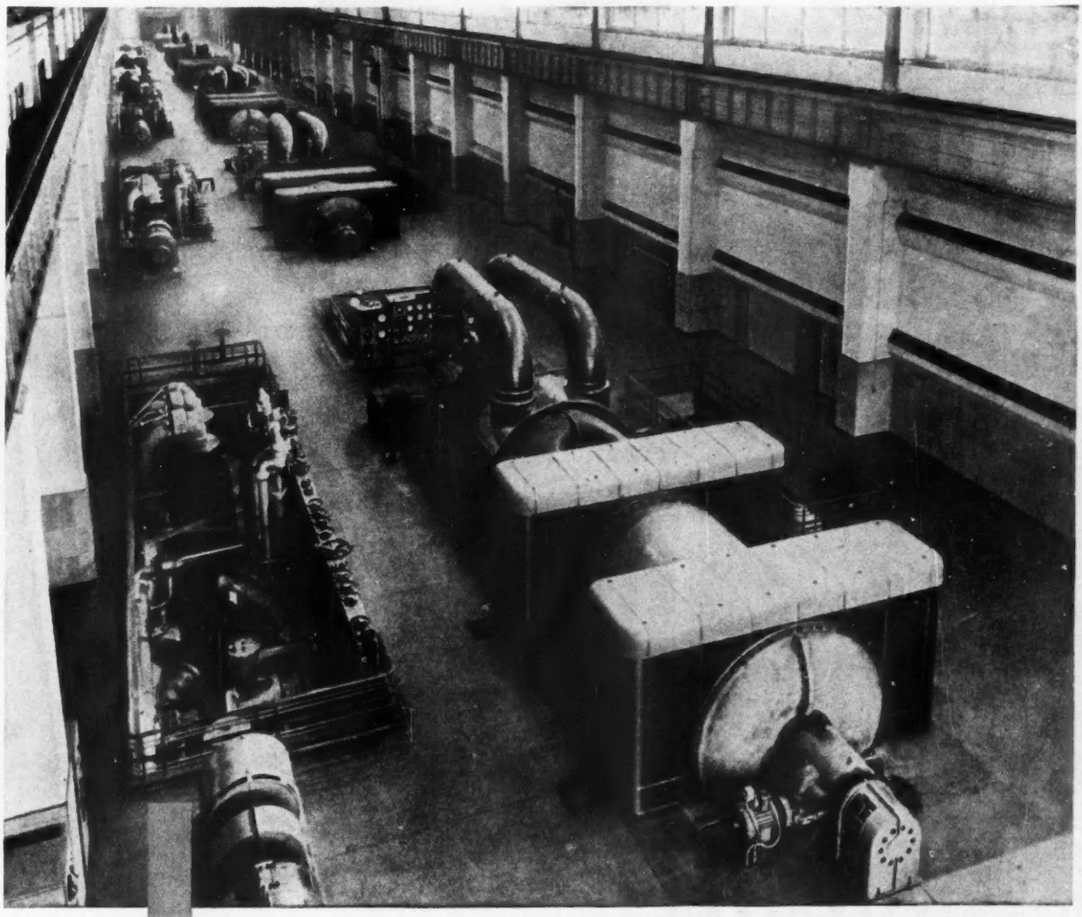

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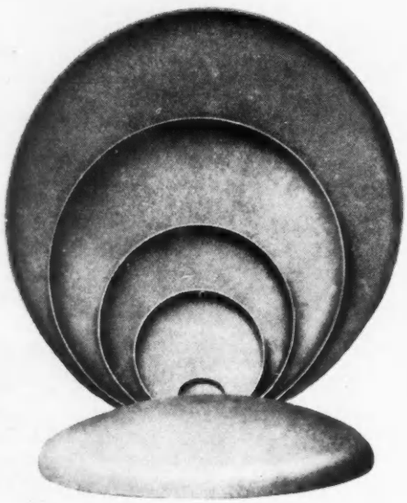

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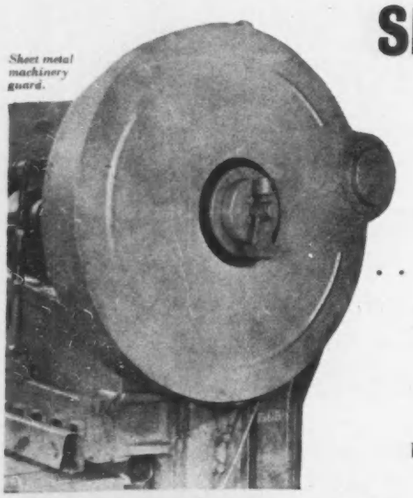

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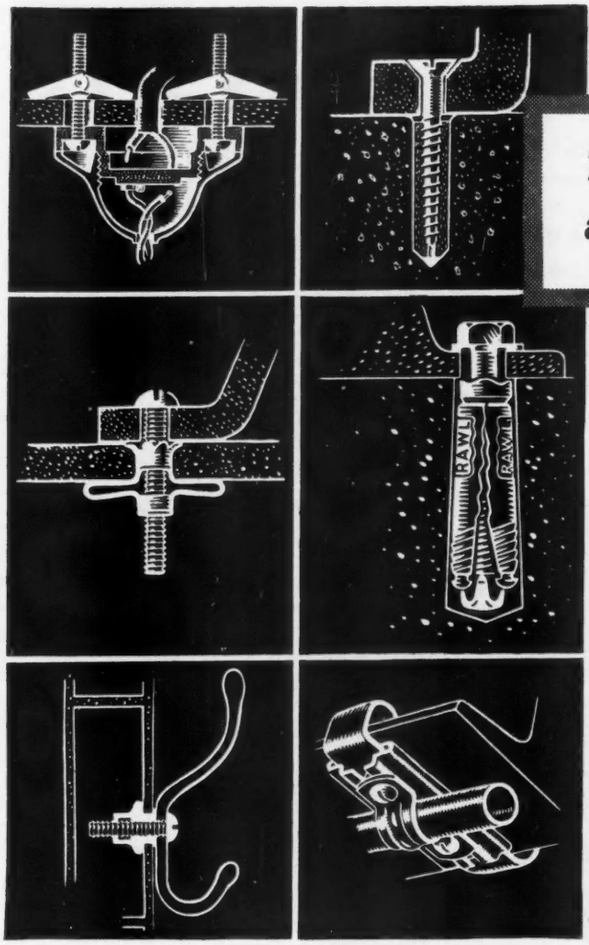

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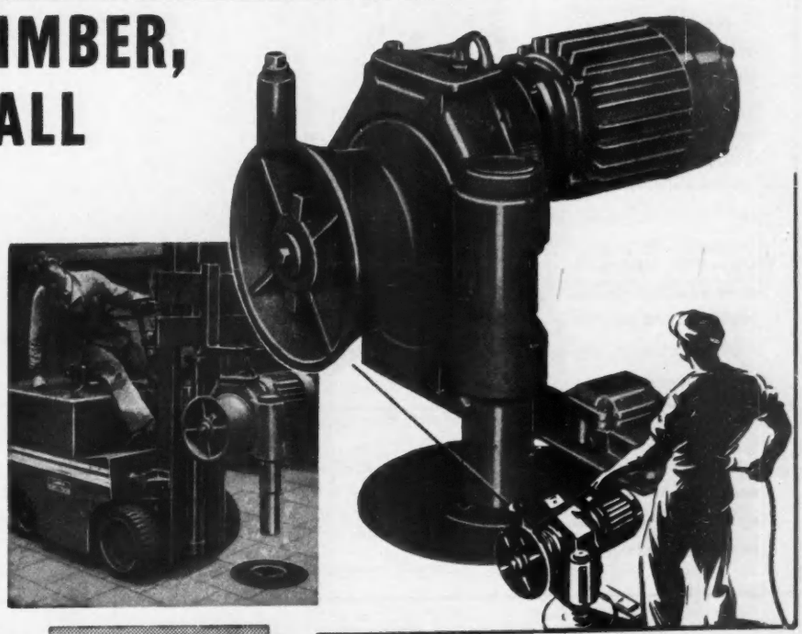

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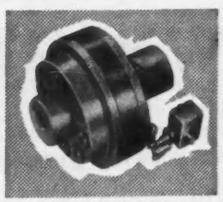

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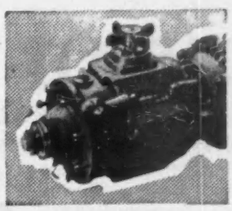

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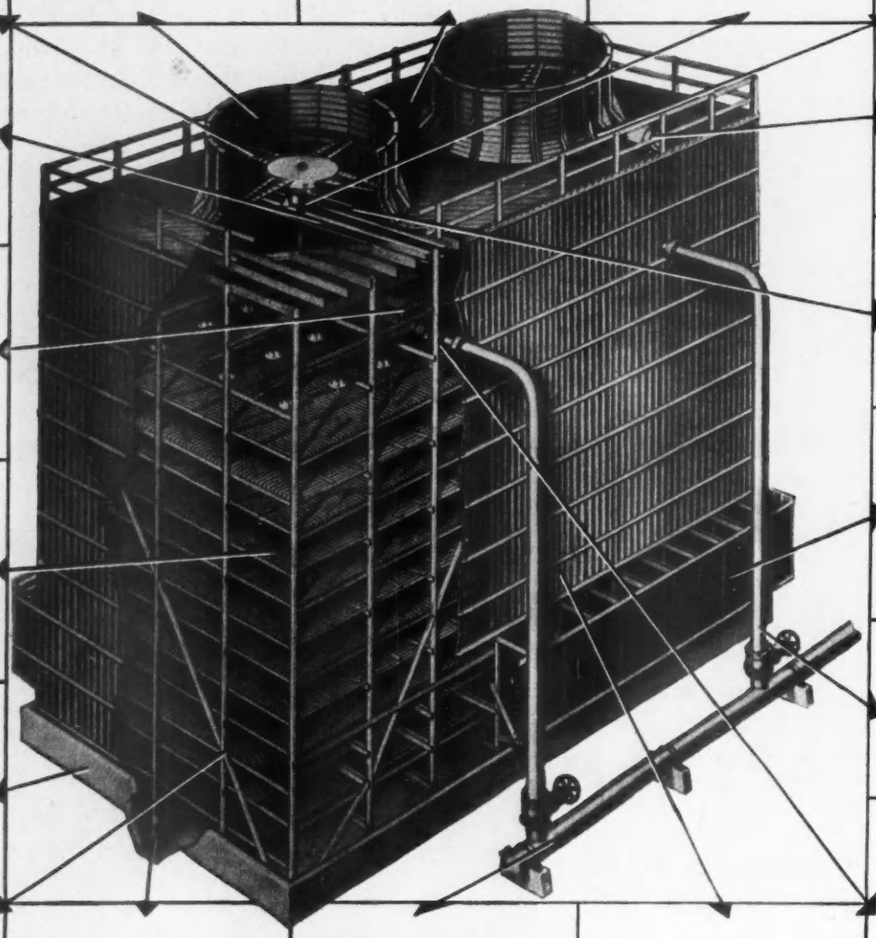

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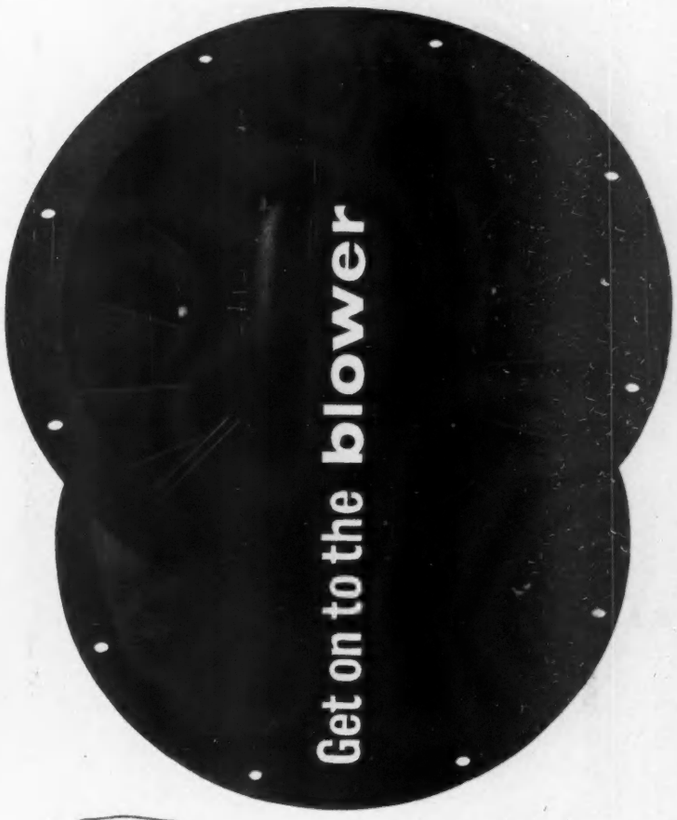

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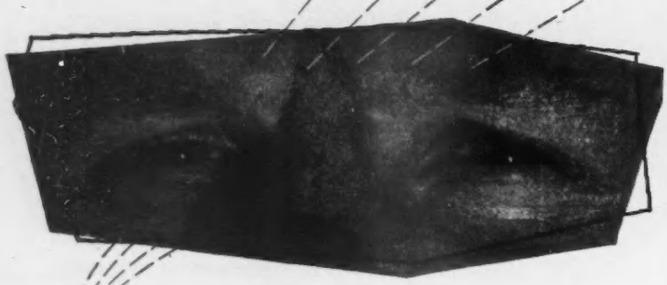

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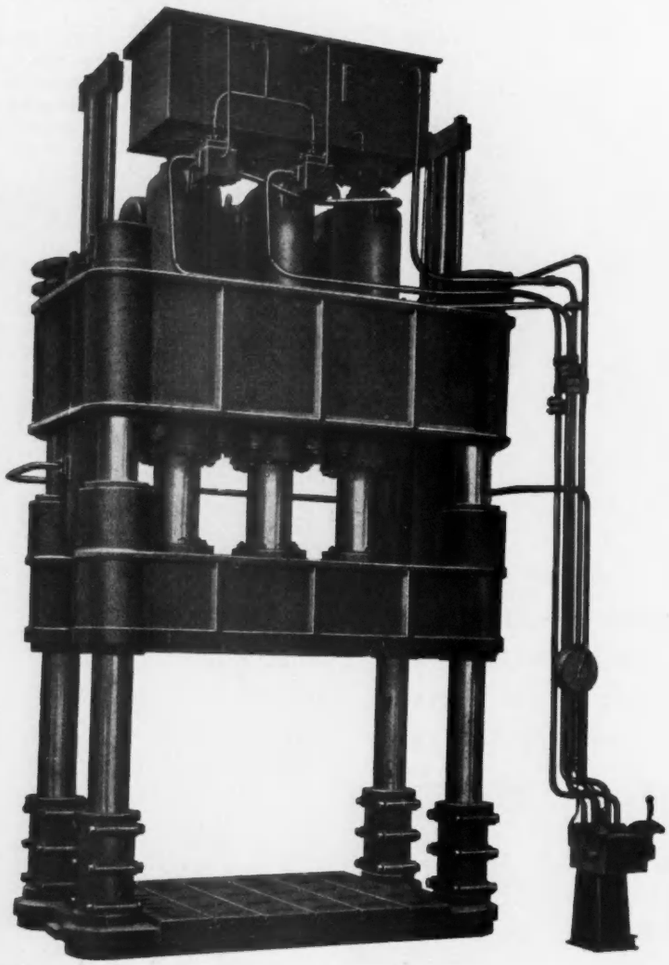

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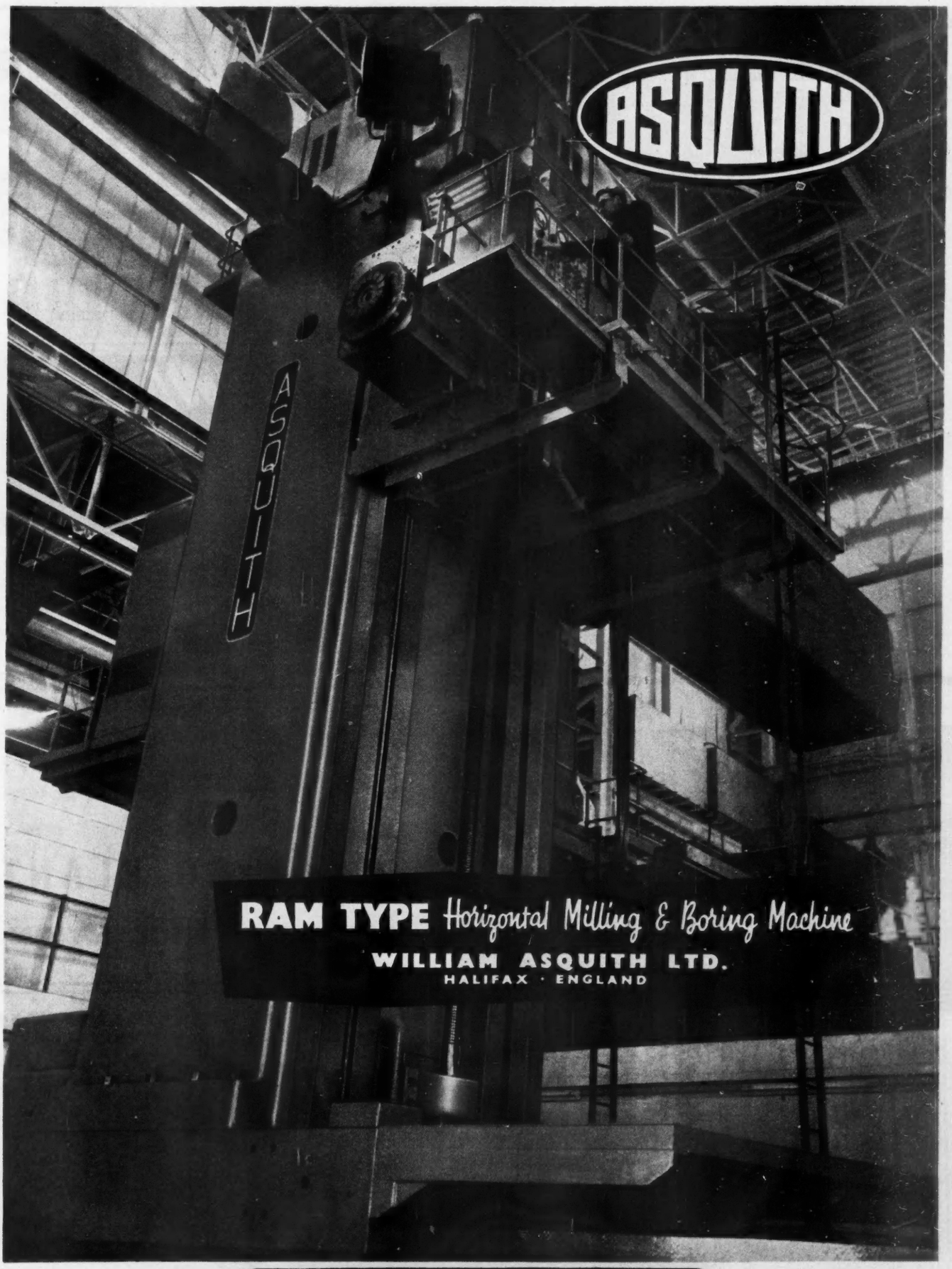

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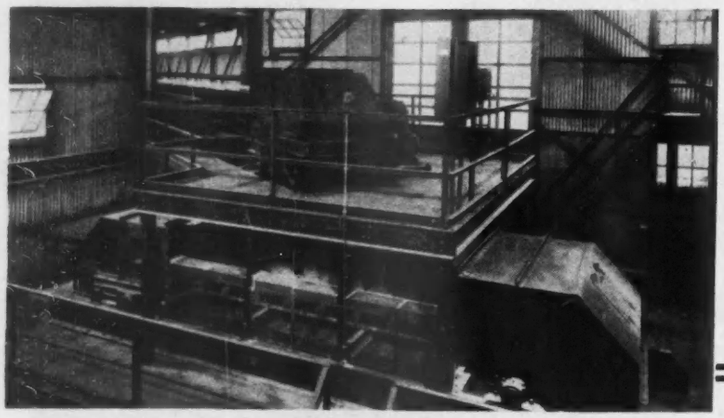

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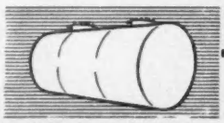
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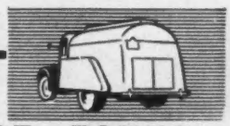

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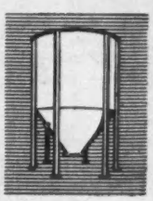

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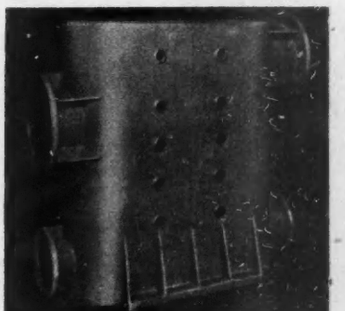

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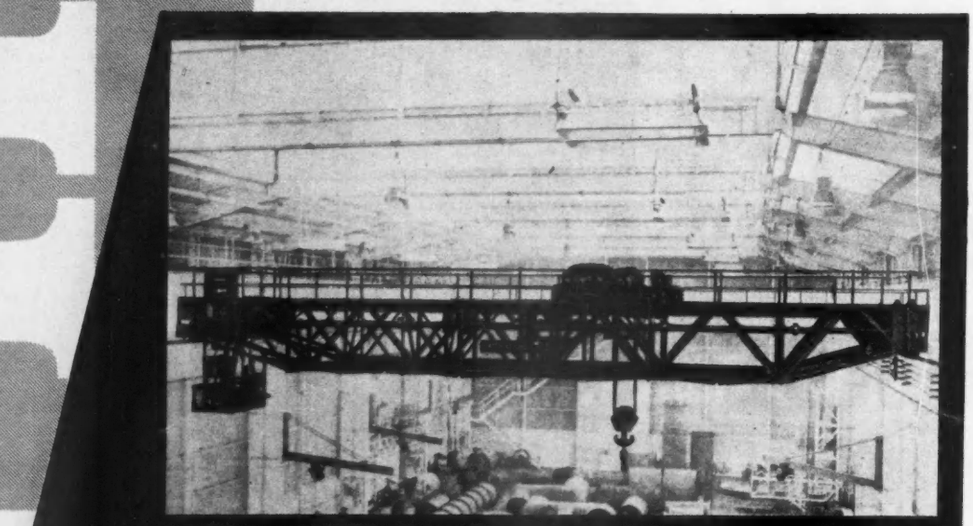

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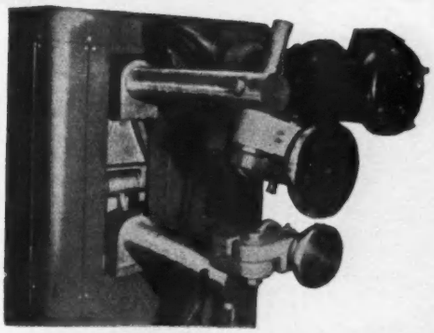

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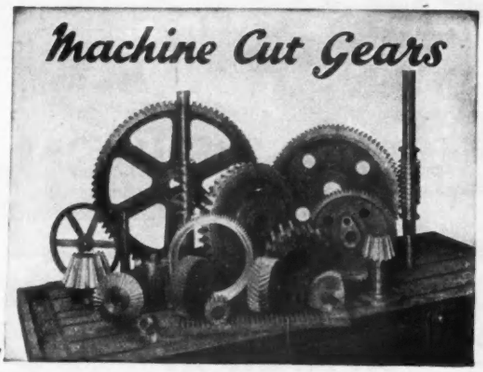

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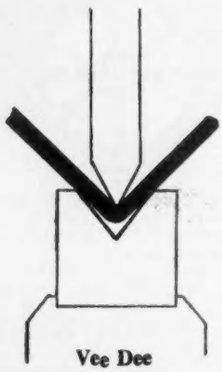
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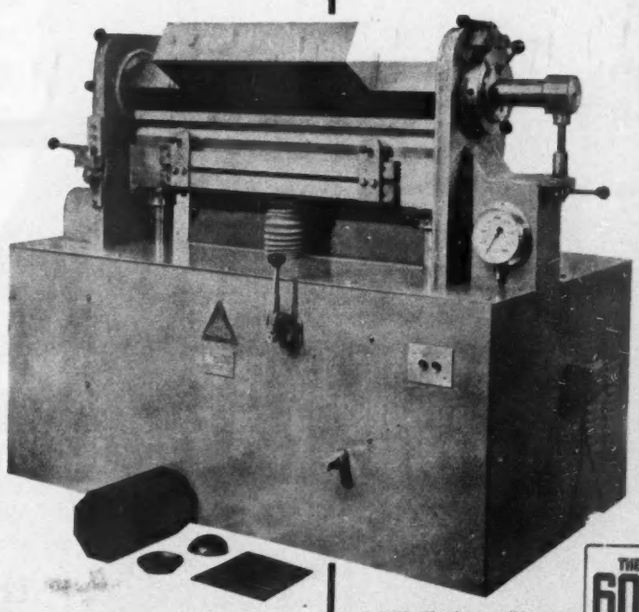

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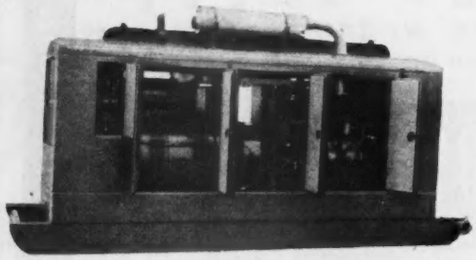

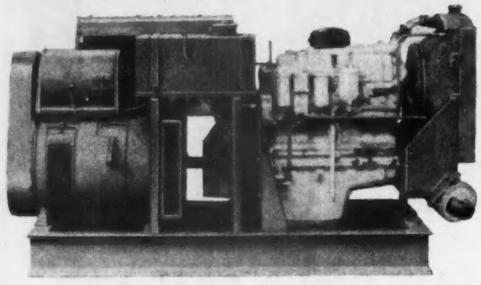

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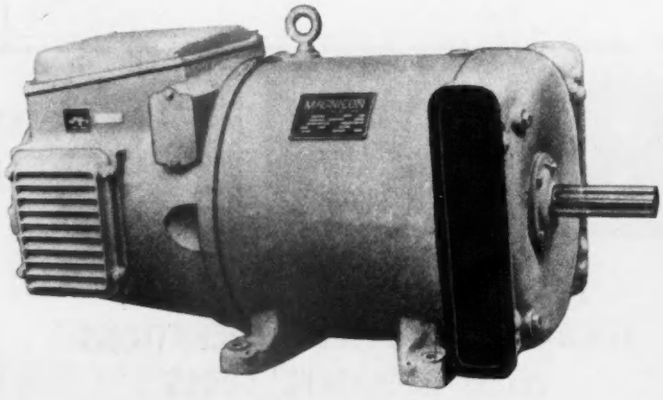

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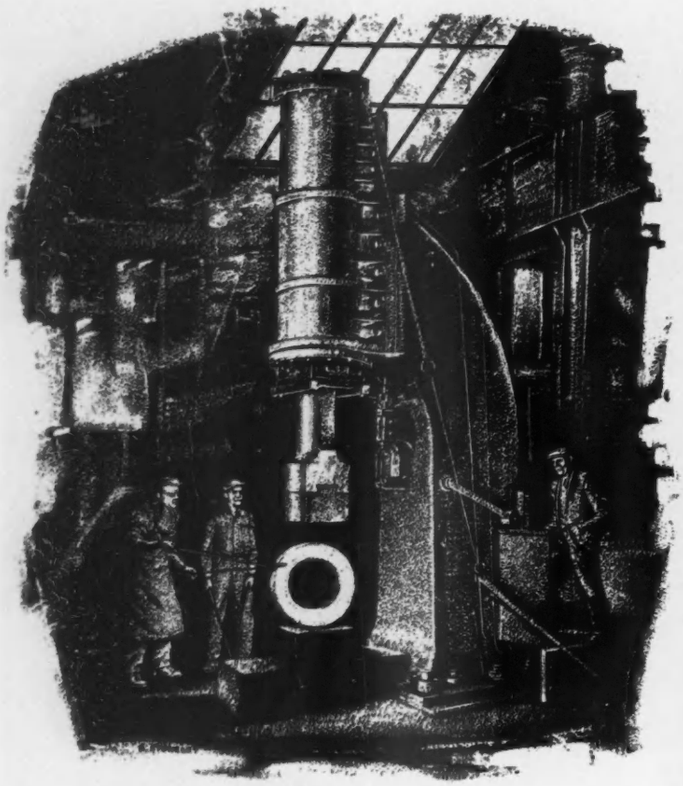

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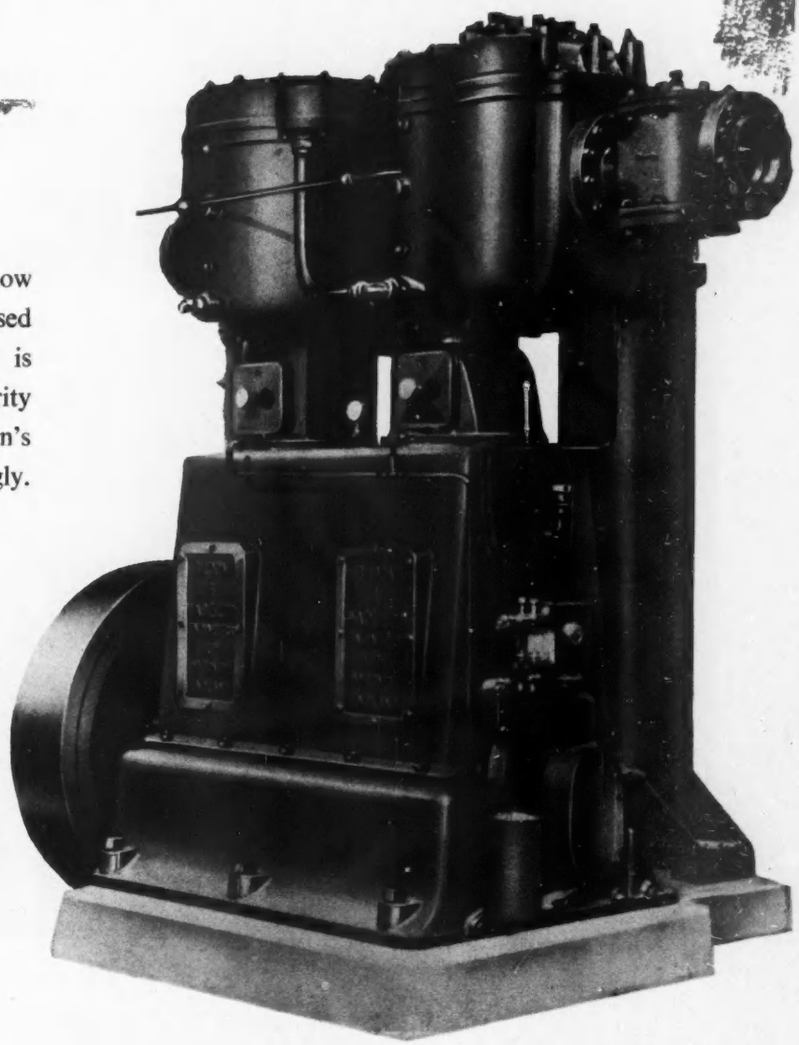

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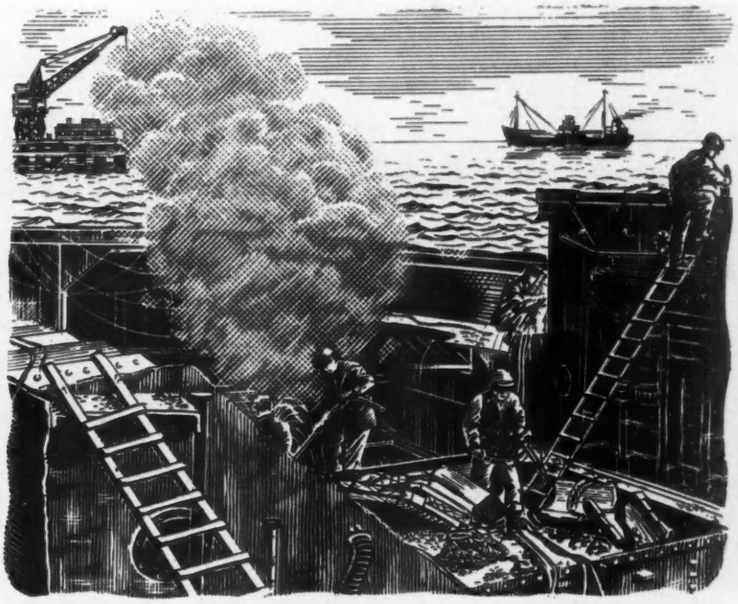

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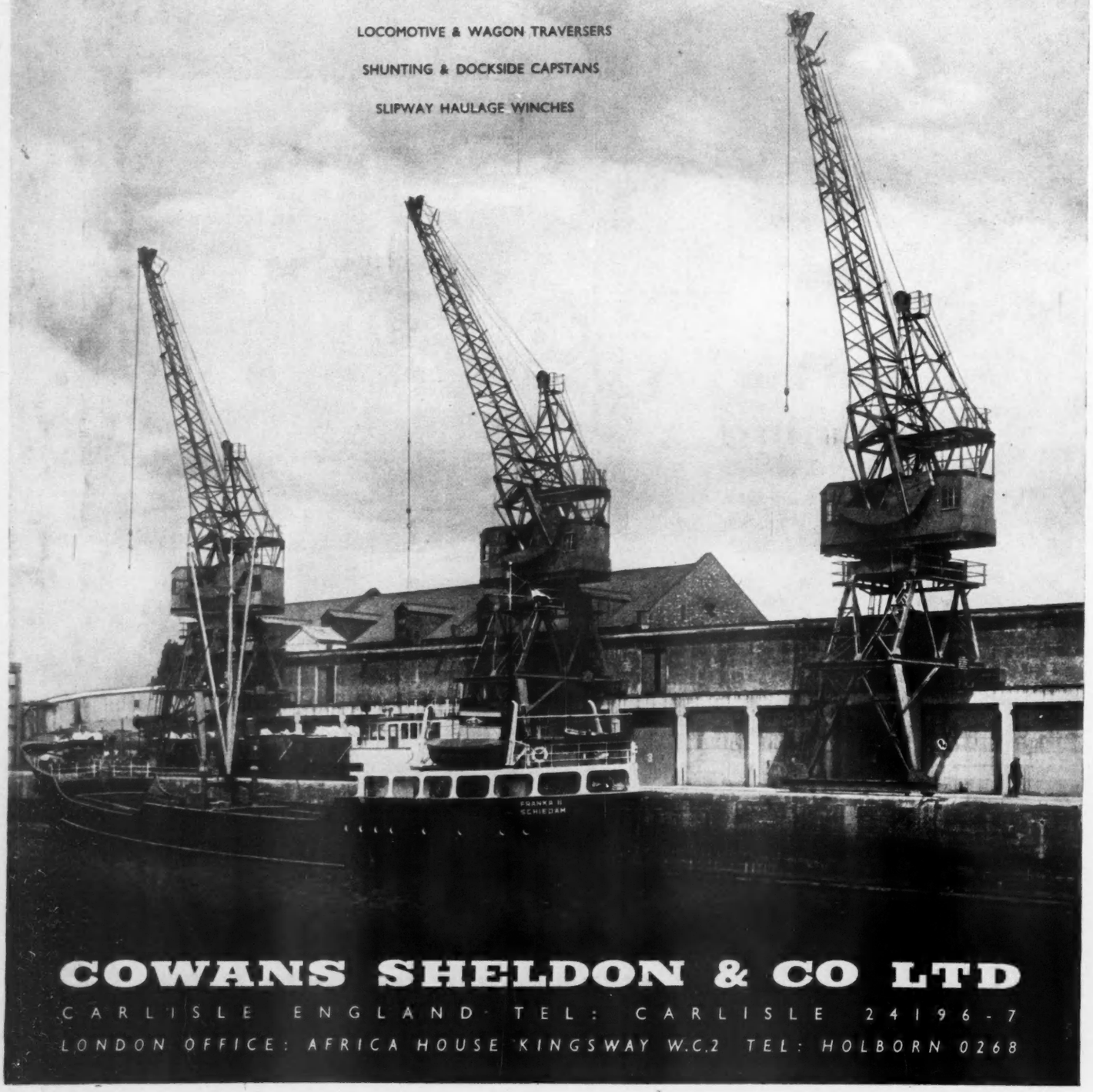

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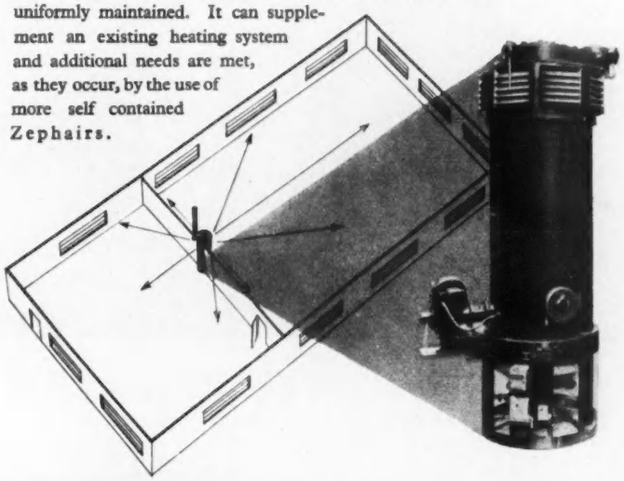

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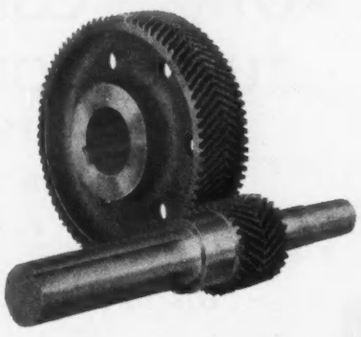

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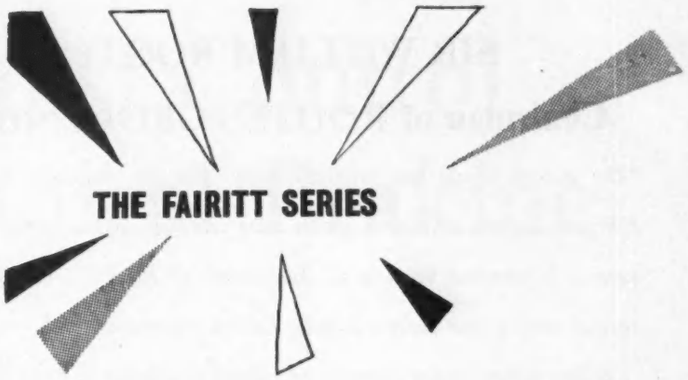

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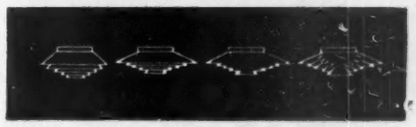

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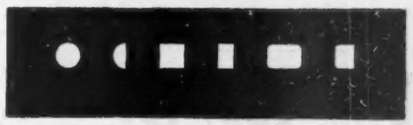

Different Shapes, Round, Square, Rectangular and Half Round, Half Square, and Half Rectangular.

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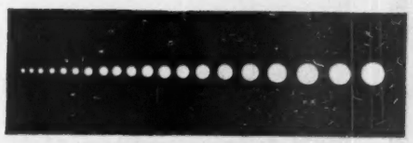

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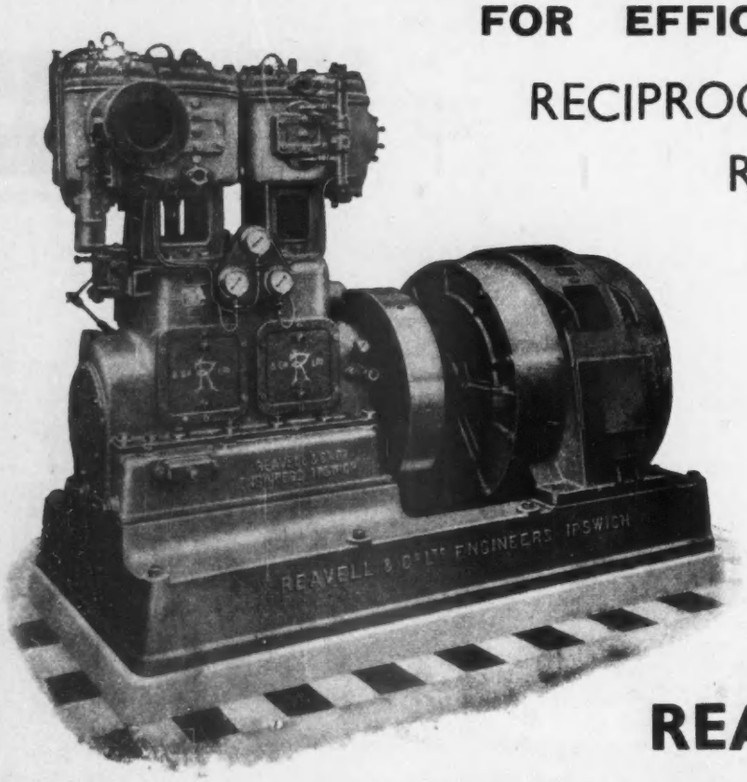

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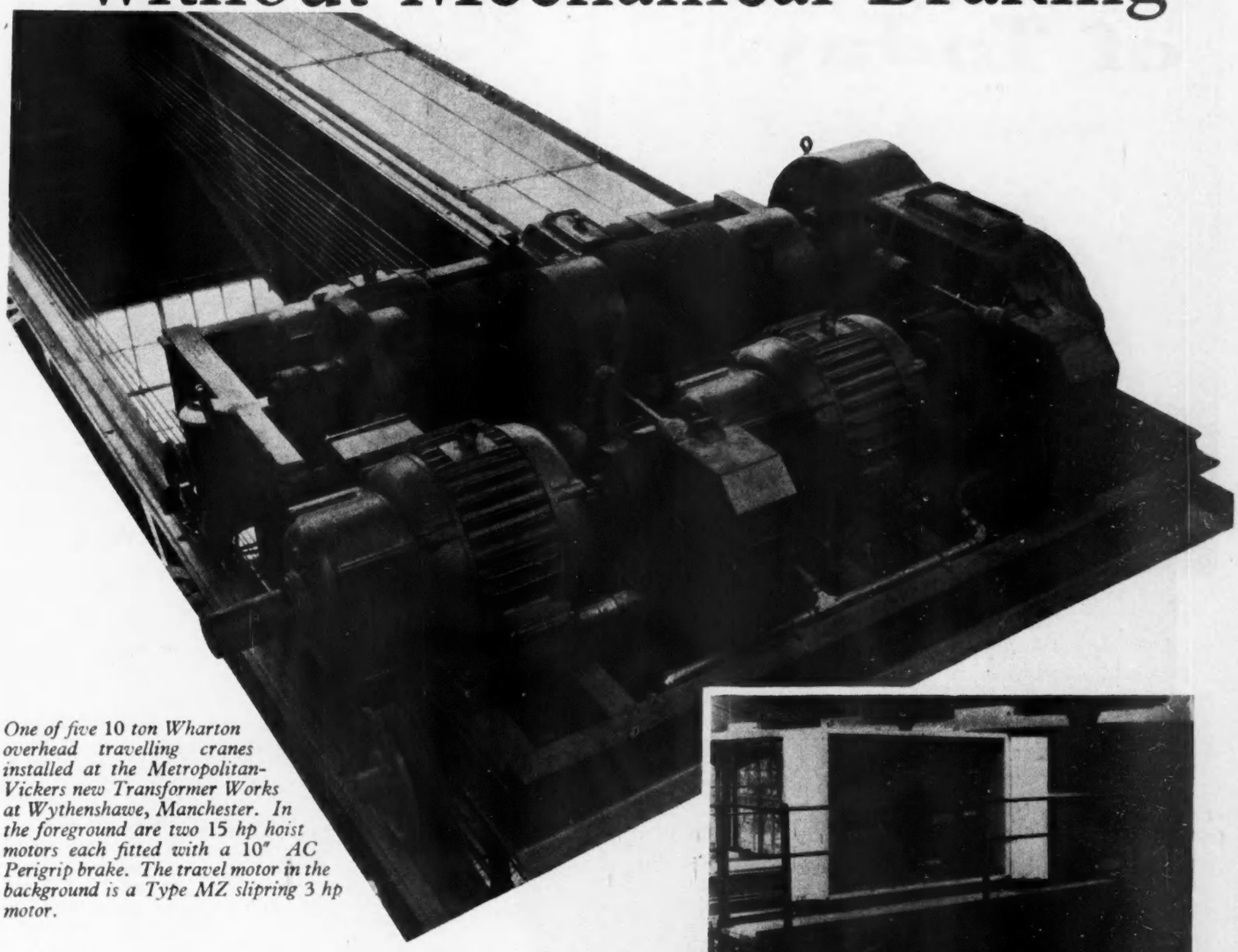
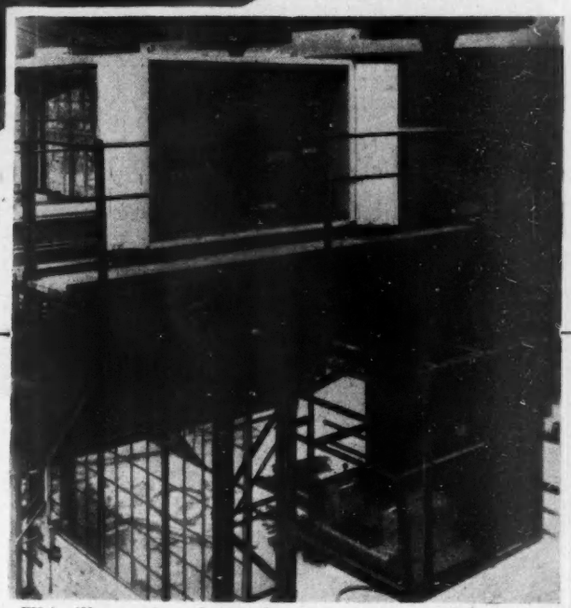


One of five 10 ton Wharton overhead travelling cranes installed at the Metropolitan-Vickers new Transformer Works at Wythenshawe, Manchester. In the foreground are two 15 hp hoist motors each fitted with a 10" AC Perigrip brake. The travel motor in the background is a Type MZ slipring 3 hp motor.



This illustration shows the contactor control gear and the operator's cabin.

The new Metrovick system of AC Crane Hoist Control employs two identical slipring induction motors, permanently geared to the hoist motion and running at the same speed. These motors running in conjunction give :—

* Creep speeds hoist and lower, varying little with load.
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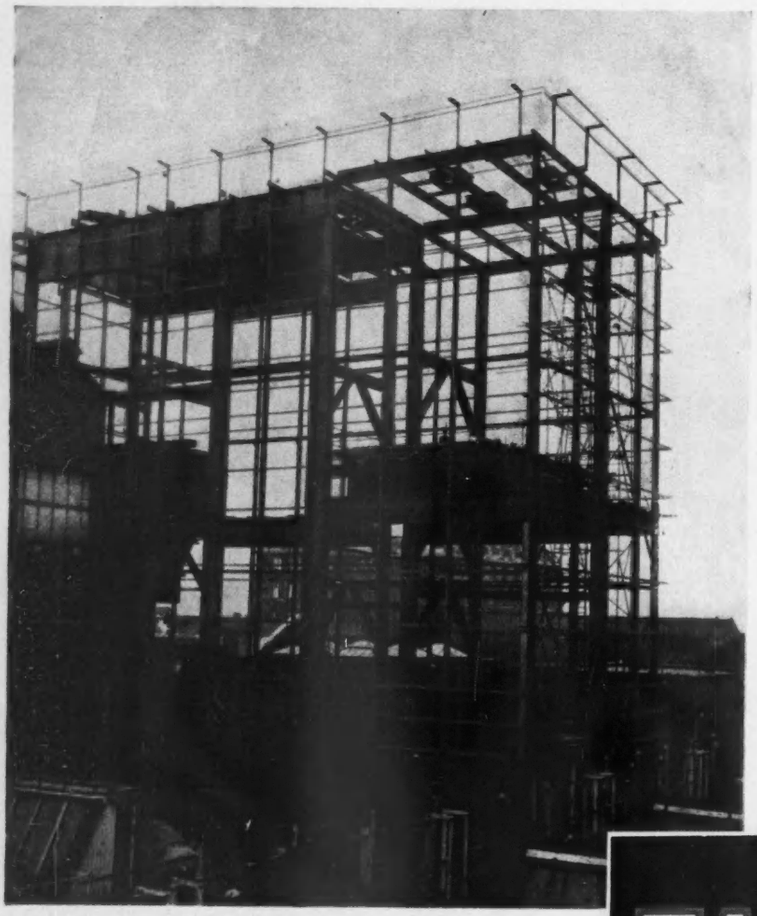

The new Boiler House for the I.C.I. Kynoch Works at Witton, Birmingham, is an impressive construction for which we fabricated and erected the steelwork. Its striking proportions provide yet another of to-day's landmarks.

Illustration by courtesy of Imperial Chemical Industries Limited, Metals Division.

Steelwork to the design of Babcock & Wilcox Limited, London and Renfrew.

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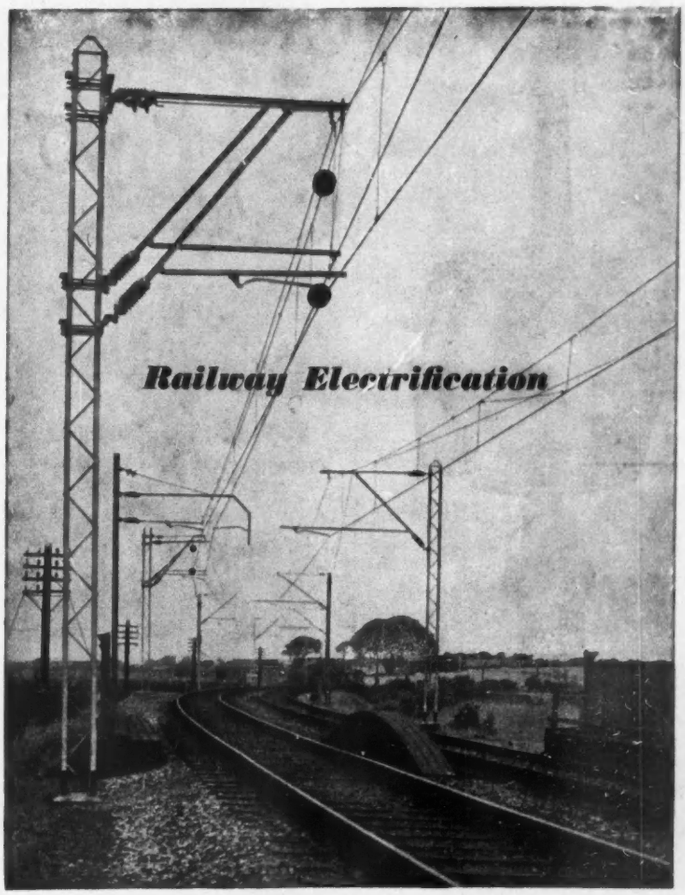

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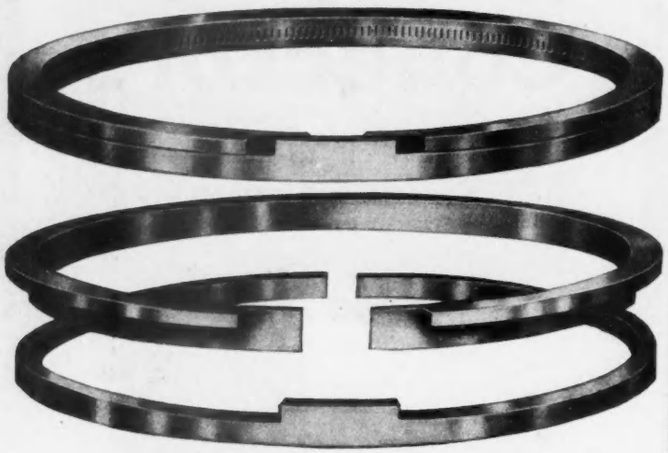

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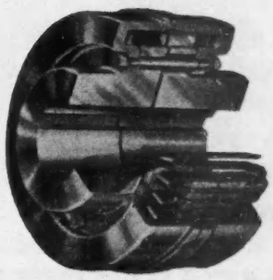

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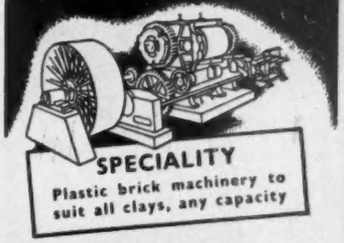

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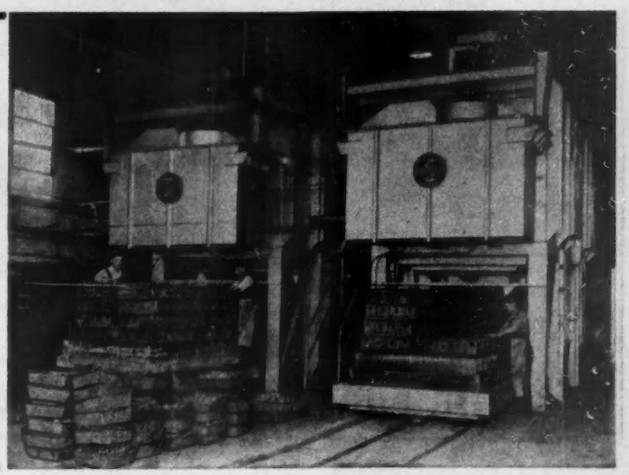

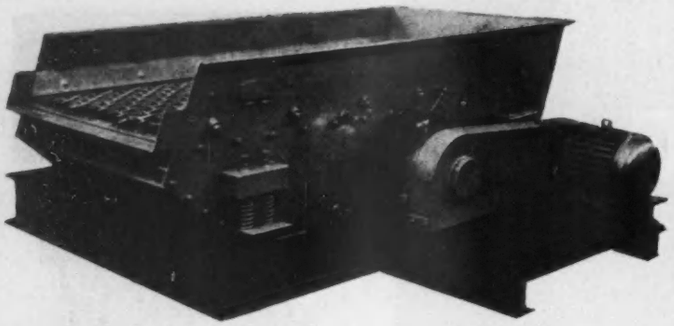

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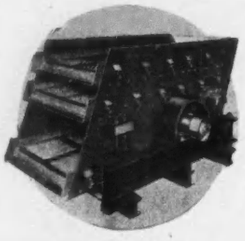

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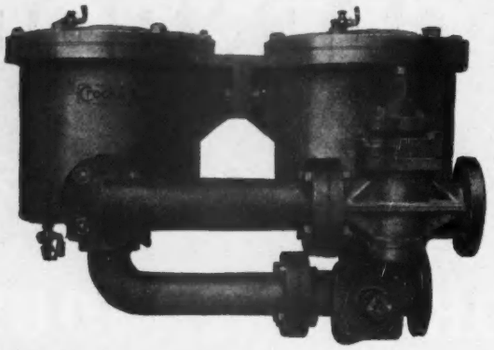

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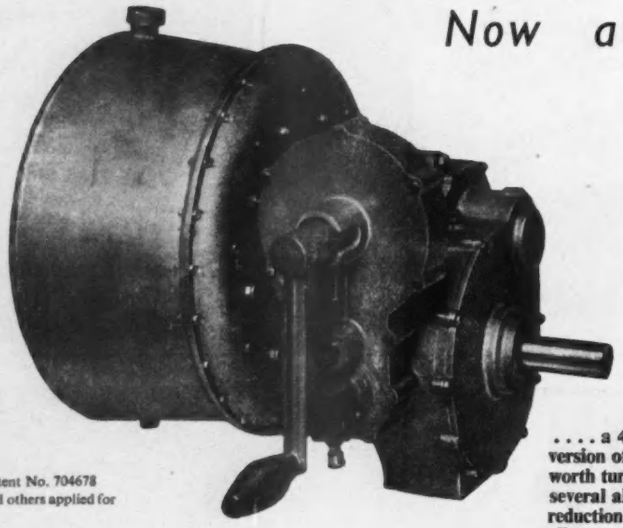

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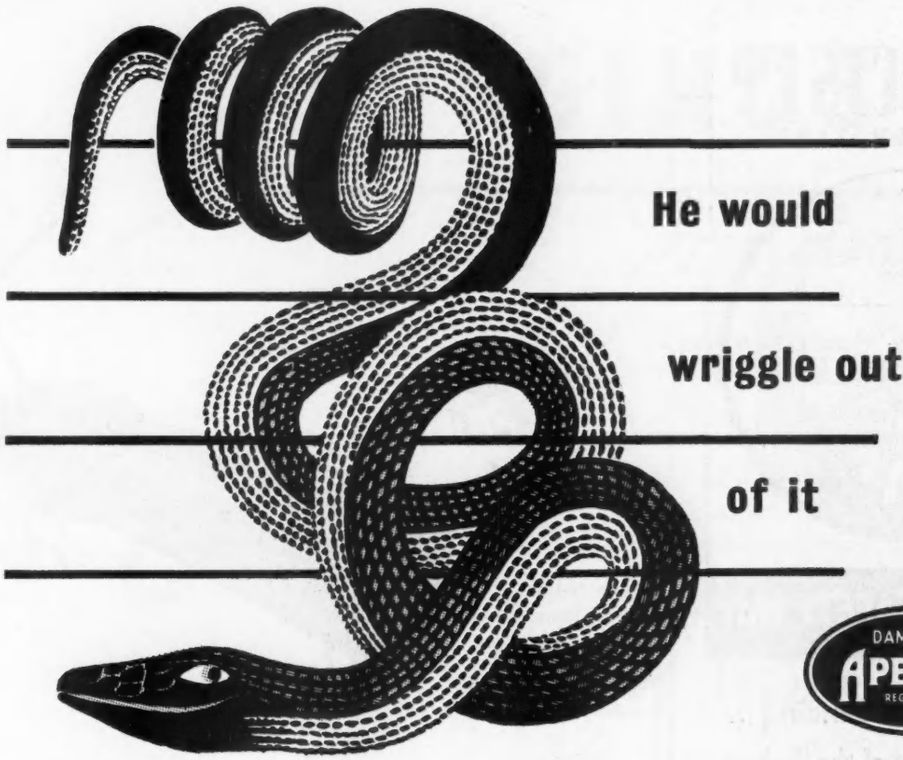

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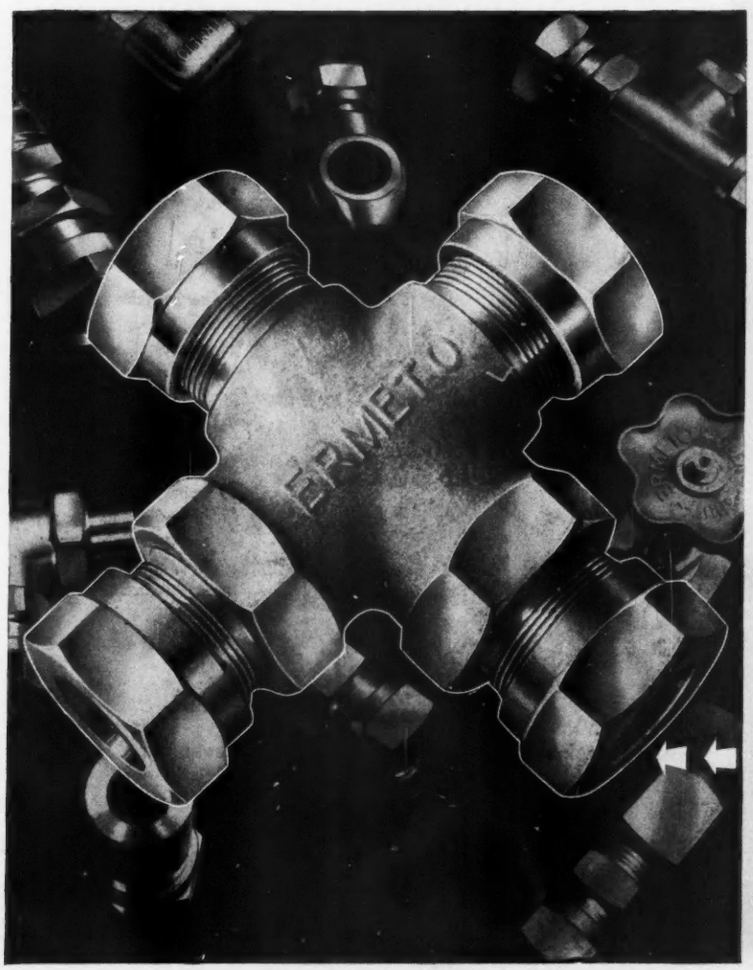

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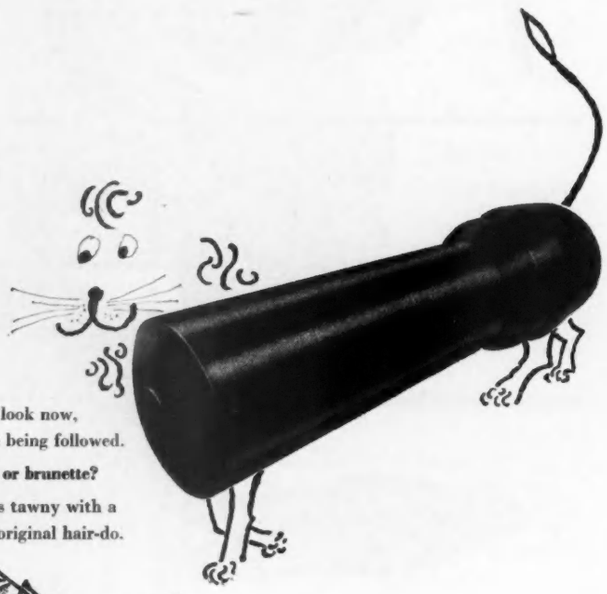

Don't look now, but we're being followed.

Blonde or brunette?

This one's tawny with a rather original hair-do.

The most striking thing about her, though, is her figure.

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No, old man—48, 35, 23. And not a seam or a weak spot anywhere.

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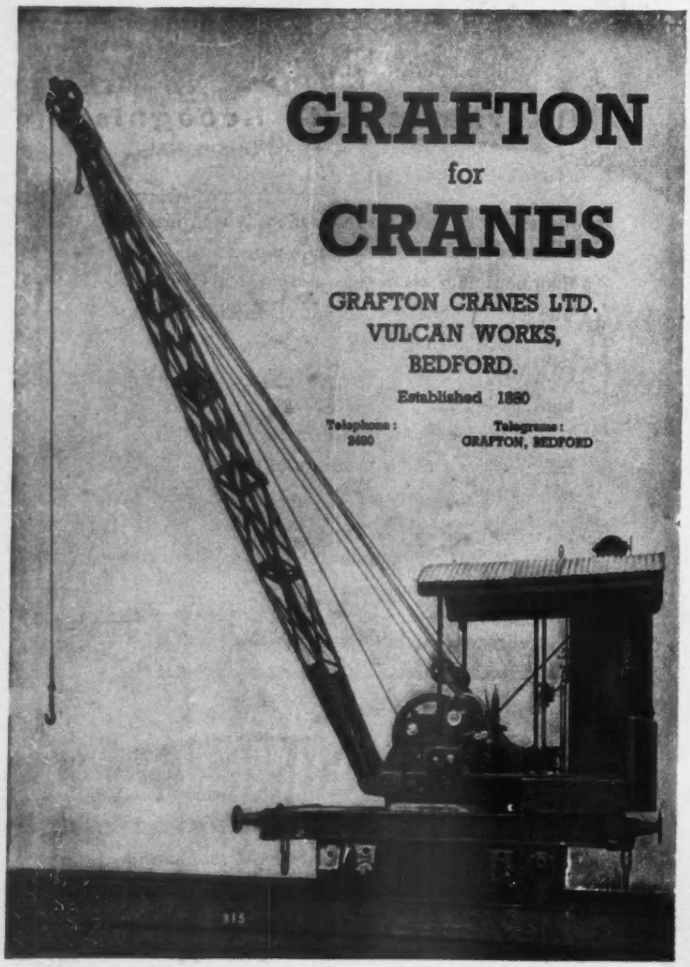

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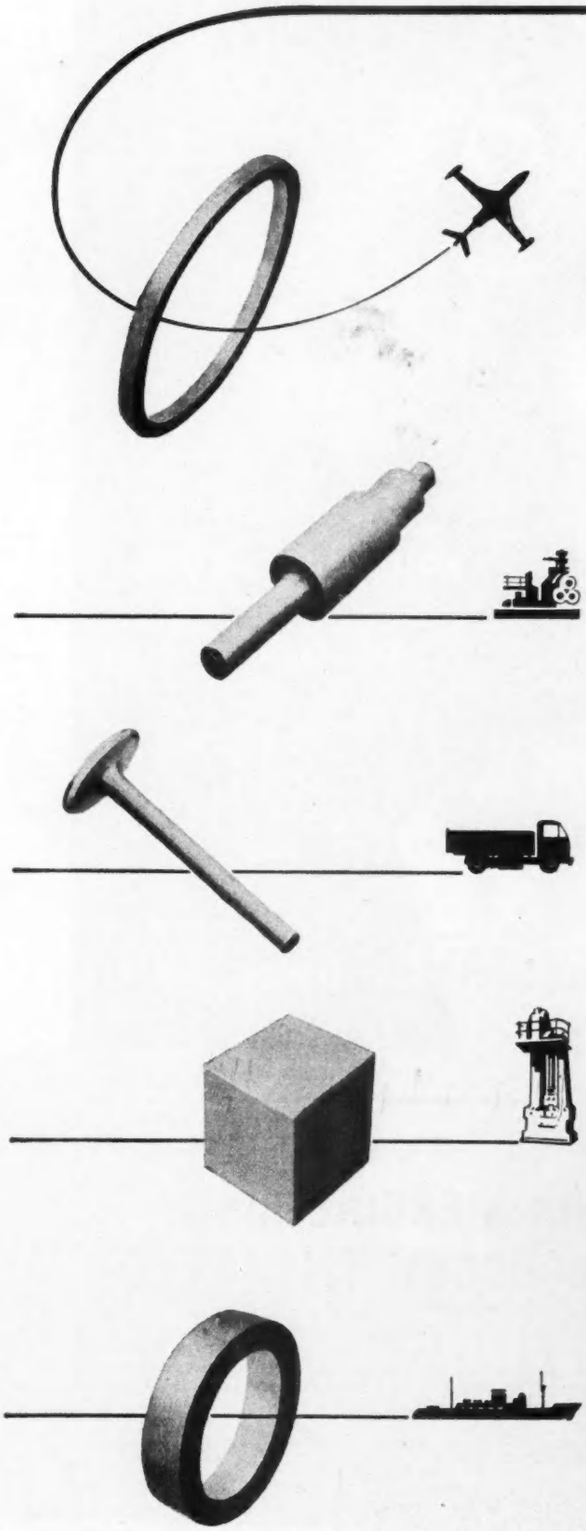

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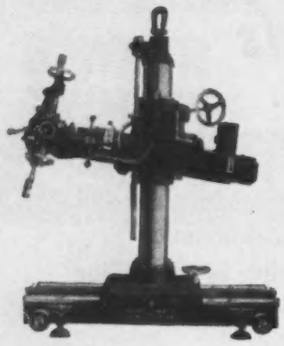

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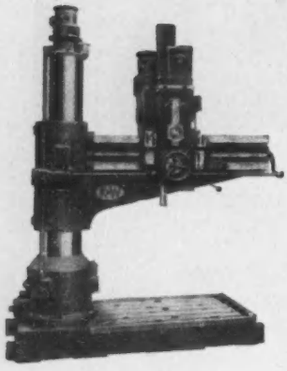
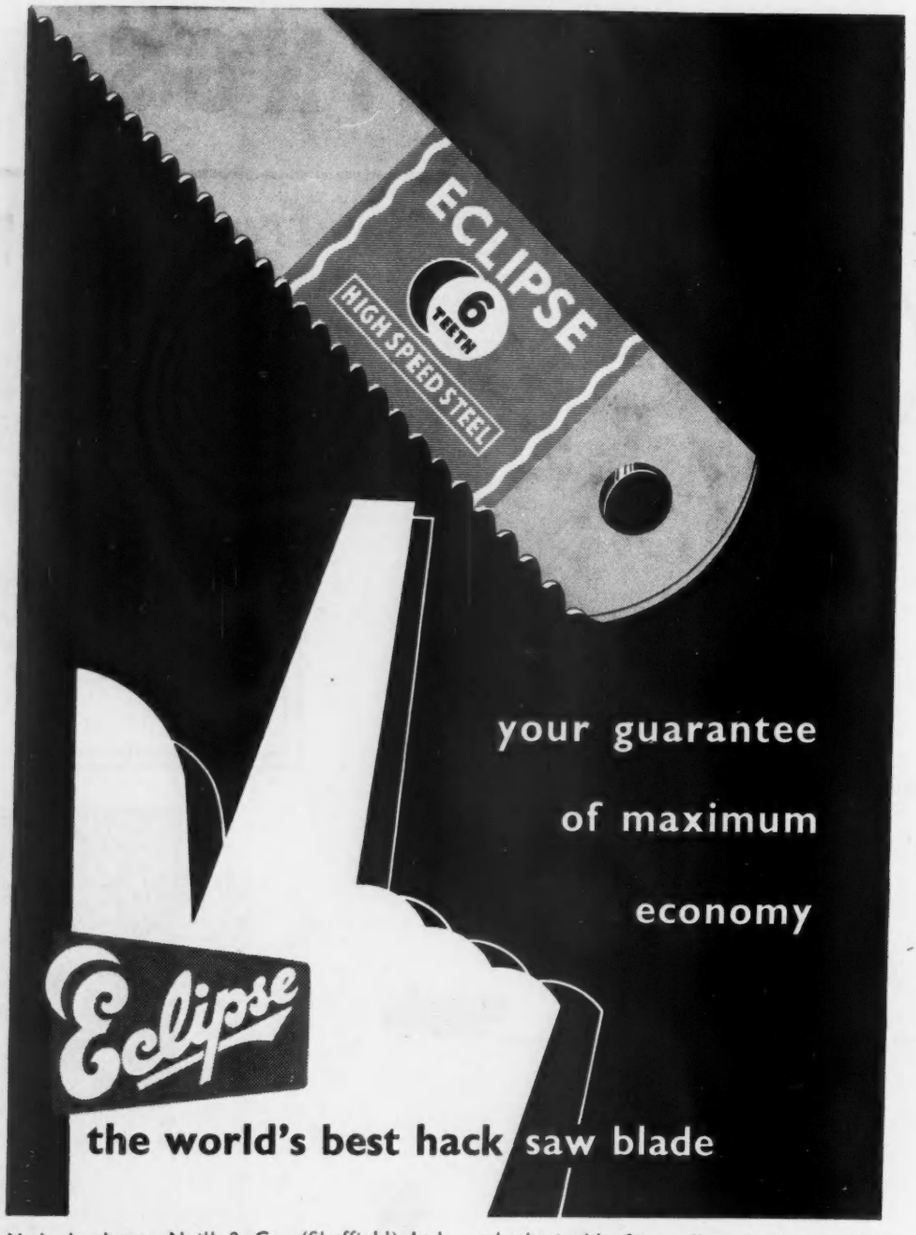
32" and 40" sizes



E.27
36 Speed Radials
6ft., 7ft. and 8ft. radius

KITCHEN & WADE LTD.
HALIFAX, ENGLAND
Phone : Halifax 61173



Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors

UH14

SHEET METAL WORK & ENGINEERING FOR *EVERY INDUSTRY

For many years we have enjoyed a reputation for work of the highest quality and precision finish. Our spacious workshops house some of the most up-to-date metal working machinery and our resources are available to those who require prototypes or pilot runs as well as to those whose demand is for quantity production.

*** AUTOMOBILE**
Body panels, wings, cabs, silencers, petro tanks, etc., etc.

*** ELECTRONICS**
Main control cabinets, instrument panels and boxes, receiver chassis, etc.

*** AIRCRAFT**
Fuel tanks, elevators, tail planes, pressings, fabrications in all metals.

Our Sheet Metal Working Plant includes:
Presses up to 200 tons, Guillotines, Wiring Machines, Press Brakes, Benders, Riveting and all types of Welding and General Engineering Plant.

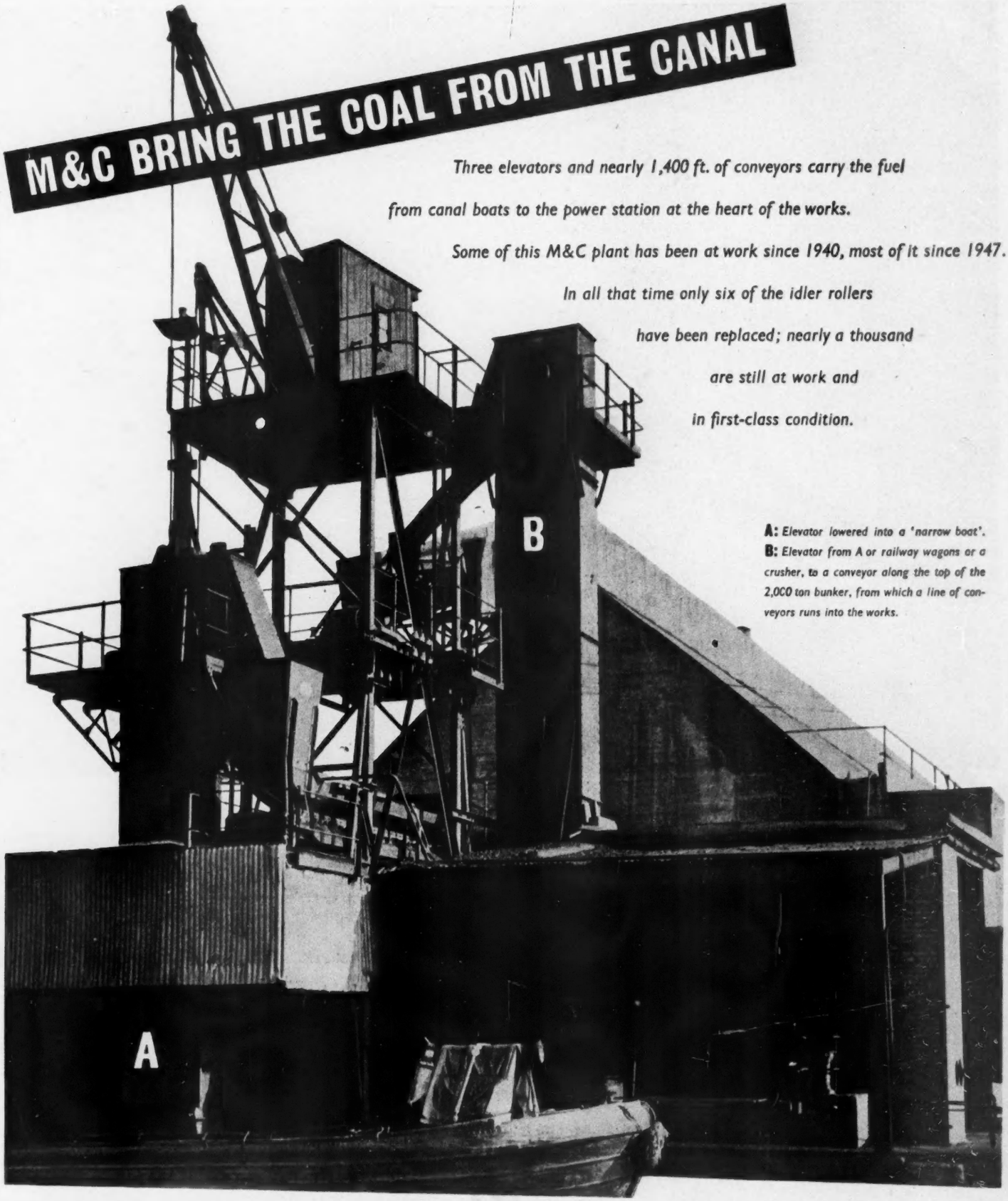
E. G. Brown & Co. Ltd

WEST ROAD, TOTTENHAM, LONDON, N.17
Telephone: TOTtenham 2257-8-9

M&C BRING THE COAL FROM THE CANAL

Three elevators and nearly 1,400 ft. of conveyors carry the fuel from canal boats to the power station at the heart of the works.

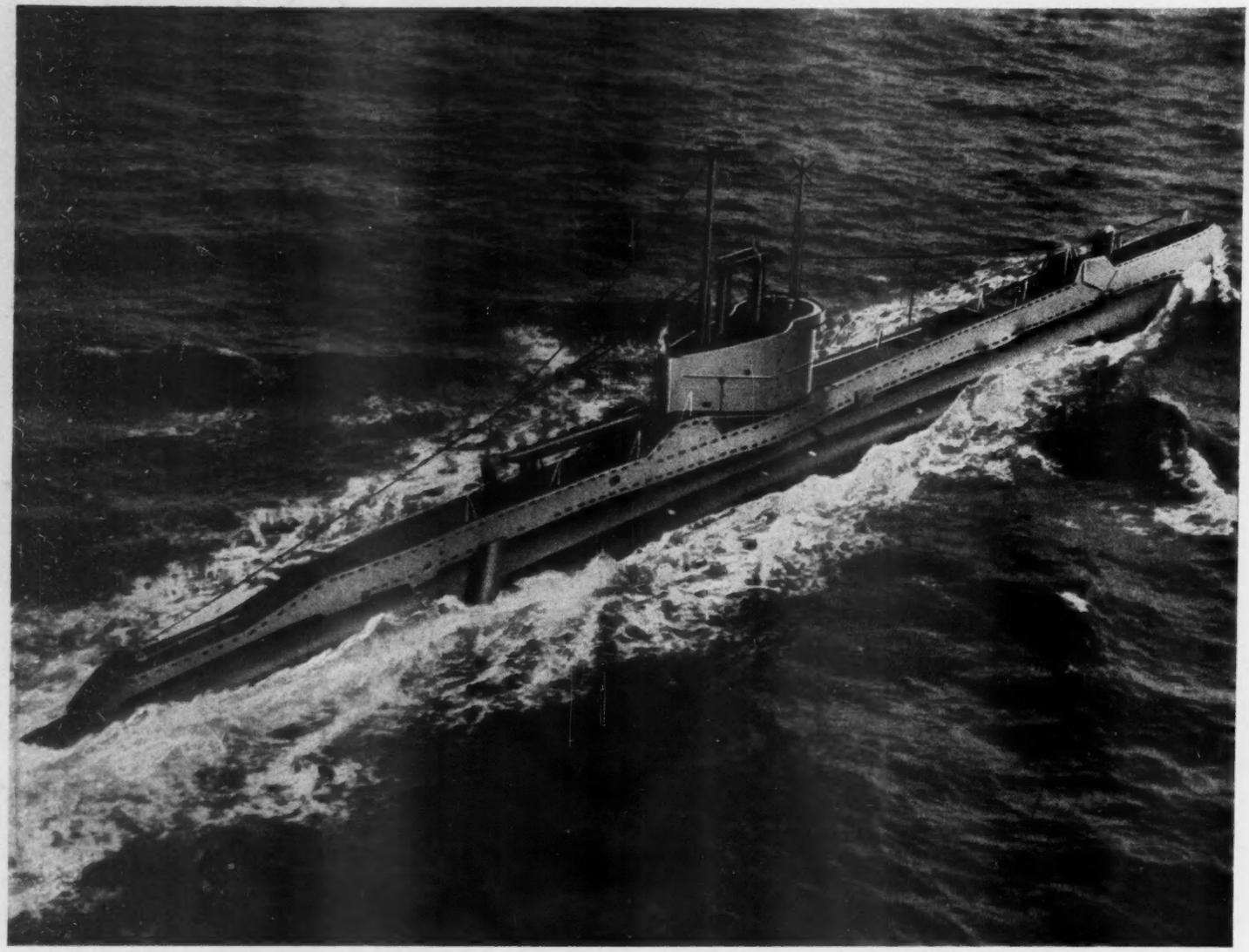
Some of this M&C plant has been at work since 1940, most of it since 1947. In all that time only six of the idler rollers have been replaced; nearly a thousand are still at work and in first-class condition.



A: *Elevator lowered into a 'narrow boat'.*
B: *Elevator from A or railway wagons or a crusher, to a conveyor along the top of the 2,000 ton bunker, from which a line of conveyors runs into the works.*

MAVOR & COULSON LTD

Bridgeton, Glasgow S.E. · Olive Grove Road, Sheffield 2 · 36 Victoria Street, London S.W.1



BRITISH ALUMINIUM

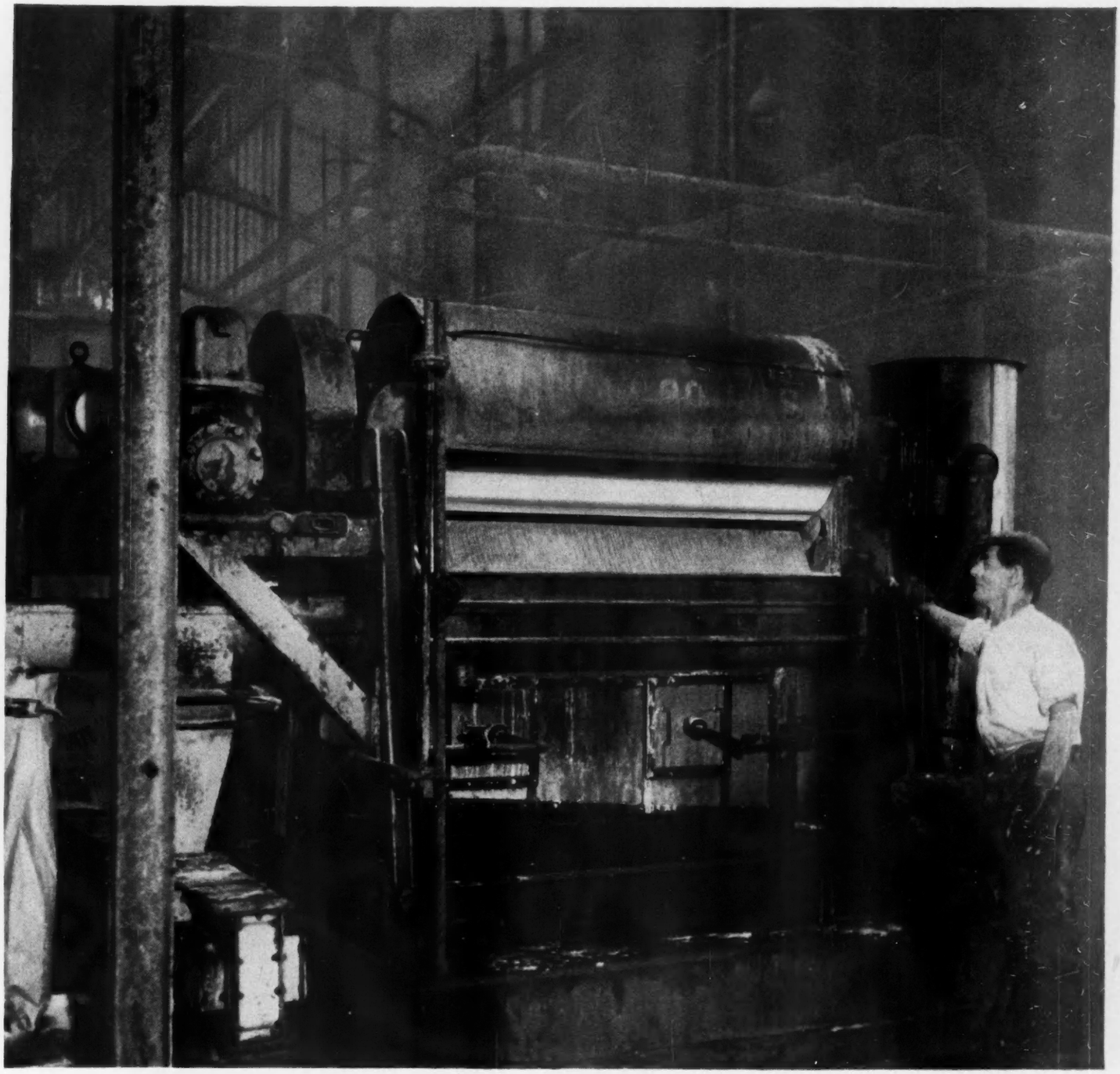
IN H.M. SUBMARINES

British Aluminium is being used in some of H.M. Submarines for the casing as well as for certain minor bulkheads, hatches in the casing, escape trunks, and indicator buoys. The weight saved appreciably improves stability, while the use of sea-water-resistant aluminium alloys reduces maintenance to a minimum.

The BRITISH ALUMINIUM Co Ltd

NORFOLK HOUSE ST JAMES'S SQUARE LONDON SW1

AP82



'Fescol'-ise and forget corrosion

The drums of this film dryer, used by the Ever Ready Company (Gt. Britain) Limited in the production of manganese sulphate monohydrate, have been deposited with hard chromium by Fescol.

The Fescol process of electro-deposition in chromium or nickel protects equipment against corrosion and provides a hard, long wearing, low friction surface. In the chemical industry such items as autoclaves, cooling coils, doctor blades, evaporator tubes, filters, heat exchange plates and mixers are among the items which have given improved service after 'Fescol'-ising.

*For further information please write for publication No. E.*1

FESCOL

Established 1920

FESCOL LIMITED · NORTH ROAD · LONDON N.7

BRANCH WORKS AT PORT GLASGOW, HUDDERSFIELD AND BROWNHILLS

Sole Licensees for Australasia: De Havilland Aircraft Pty. Ltd., Milperra Road, Bankstown, N.S.W.

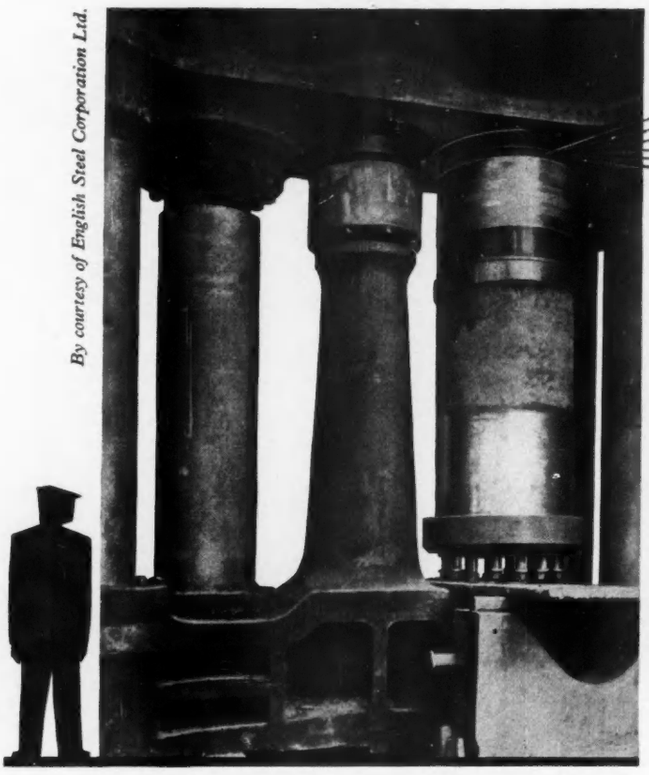
TGA 552

KRUPP ROLLS

for the hot and cold rolling of steel
and non-ferrous metals

FRIED. KRUPP · ESSEN

All enquiries and communications
to sole agents in United Kingdom:
J. M. J. MAUS Ltd.
35, New Broad Str., London, E. C. 2
Telephone: London Wall 6934/5/6
Cables: Hicbat Ave., London
Telex: London 28271



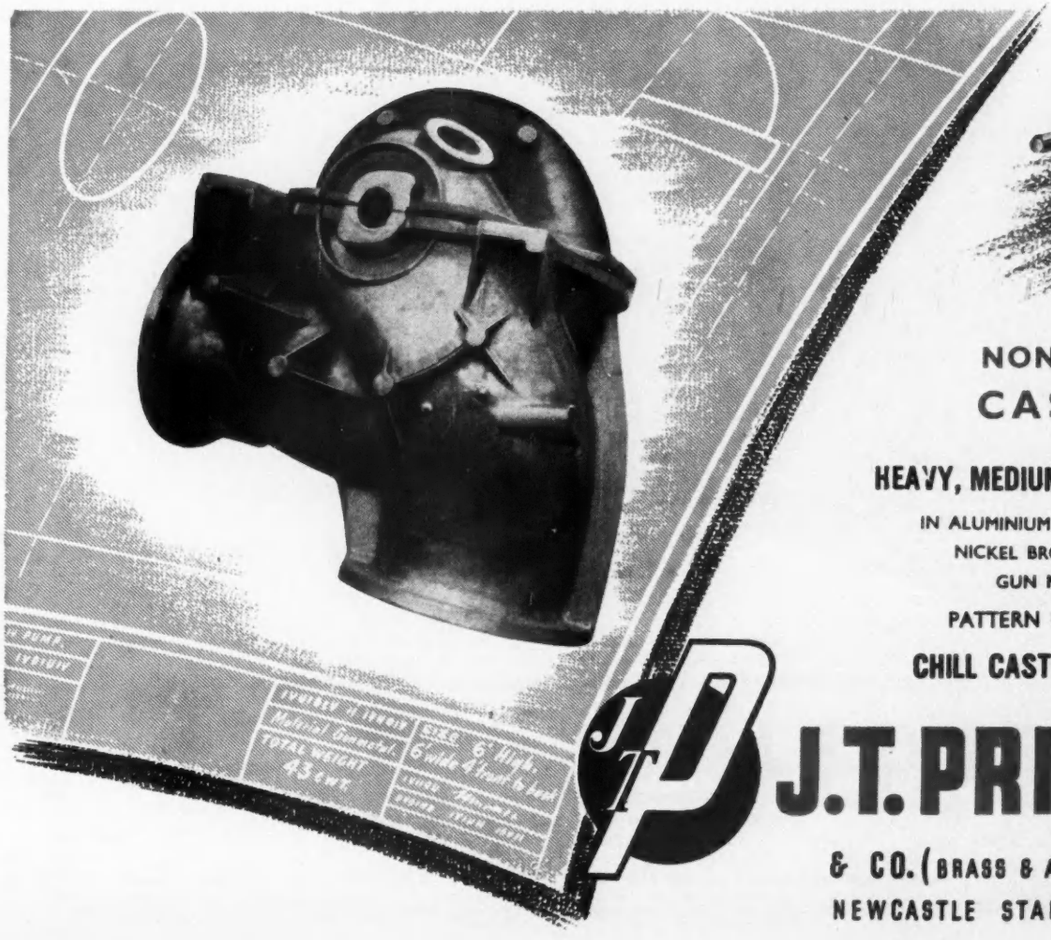
By courtesy of English Steel Corporation Ltd.

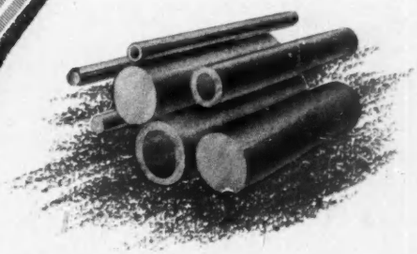
for shrink-fitting...
the 'Drikold' way is best

'Drikold' — I.C.I.'s solid carbon dioxide — provides the ideal method of producing interference fits without applying heat or pressure. And experience has shown that the 'Drikold' method is suitable for large-scale operations. The illustration shows a 7-ton cylinder which was successfully cooled by 'Drikold' and shrunk into the entablature above it. Two forged steel bushes, each weighing more than 1 cwt, were also shrunk into the entablature. 'Drikold' is a convenient, clean, dry, low-temperature refrigerant, whose use requires only simple equipment.

DK.255

Full information from:
Imperial Chemical Industries Ltd.
London, S.W.1





NON FERROUS
CASTINGS

HEAVY, MEDIUM and LIGHT SAND CASTINGS

IN ALUMINIUM BRONZES, MANGANESE BRONZES,
NICKEL BRONZES, PHOSPHOR BRONZES,
GUN METALS, ALUMINIUM, etc.

PATTERN MAKING and MACHINING

CHILL CAST SOLID and CORED BARS

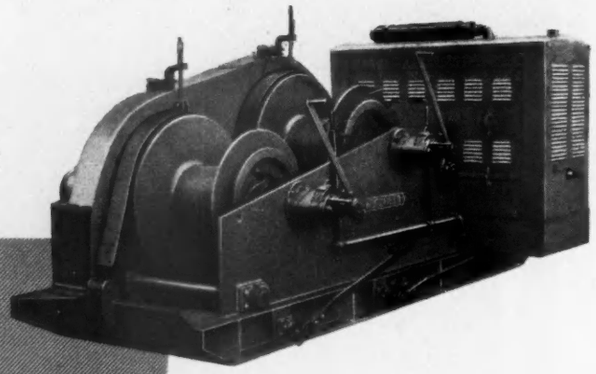
J.T. PRICE

& CO. (BRASS & ALUMINIUM FOUNDERS) LTD

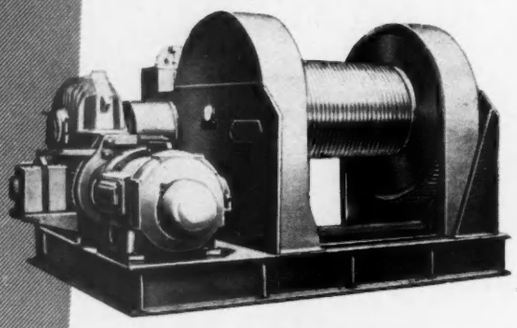
NEWCASTLE STAFFS • PHONE 68011/2/3

Consult WOODFIELD on your next winch problem

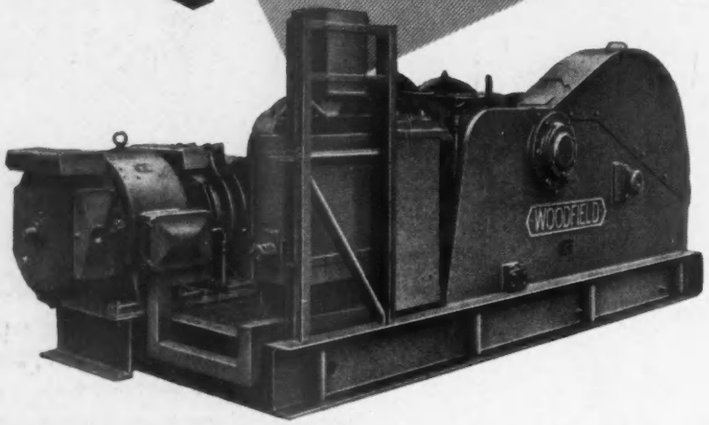
Woodfield 5-ton Double Drum Diesel Winches for Pile Driving, Derrick or general haulage duty.



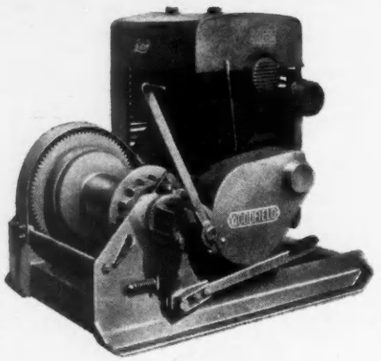
Woodfield electrically driven Slipway Winches. 58 H.P. motor geared to give 14.5 tons line pull.



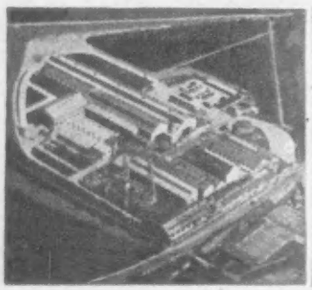
Woodfield special purpose winches for raising and lowering marine mineral boring tower. Driven by 45 H.P. electric motor, these winches have a line pull of 30 tons.



Woodfield diesel driven single drum hoists. Capacity 20 cwts., for general purposes.



WOODFIELD *manufacture under licence the range of* IDECO *Oilfield Drilling Equipment*



WOODFIELD HOIST & ASSOCIATED INDUSTRIES LTD.

Makers under Licence of IDECO Oilfield Equipment

Frindsbury Works · Rochester · England

Telephone: STROOD 78421 (5 lines) Telegrams: WOODFIELD-TELEX-ROCHESTER Telex: 89100 WOODFIELDSTROOD

London Office: 147, Victoria Street, S.W.1

Telephone: TATe Gallery 4135 Telegraphic Address: Powerigs London

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KEMWORTHY JIG & PRESS TOOL COMPANY LTD.
HIGH STREET, COLLIERS WOOD, LONDON, S.W.19.

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YARROW

shallow draft vessels, land and marine boilers

SHIPBUILDERS

ENGINEERS

BOILERMAKERS

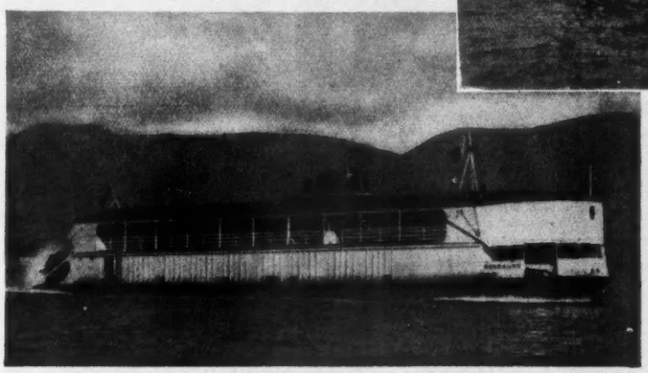
For ninety years Yarrow & Company Ltd have specialised in the design and construction of naval ships and shallow draught vessels of all types.

Yarrow Water Tube Boilers are installed in many of the world's largest and most modern Power Stations. Likewise, many of the world's most famous ships have boilers of Yarrow design.

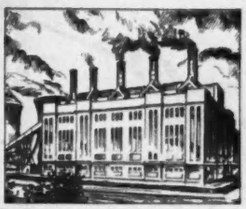
A Research Department is fully engaged in the design and development of high power propulsion machinery and nuclear activities are playing an increasing part in the work of this Department.

HMCS ST LAURENT *Anti-submarine destroyer escort vessel. Machinery installation designed and supplied by Yarrow.*

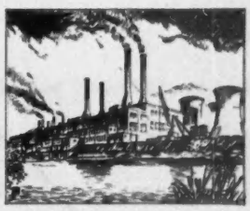
PONDAUNG *One of five quarter wheel motor passenger vessels for service on the Irrawaddy.*



ROOSECOTE POWER STATION

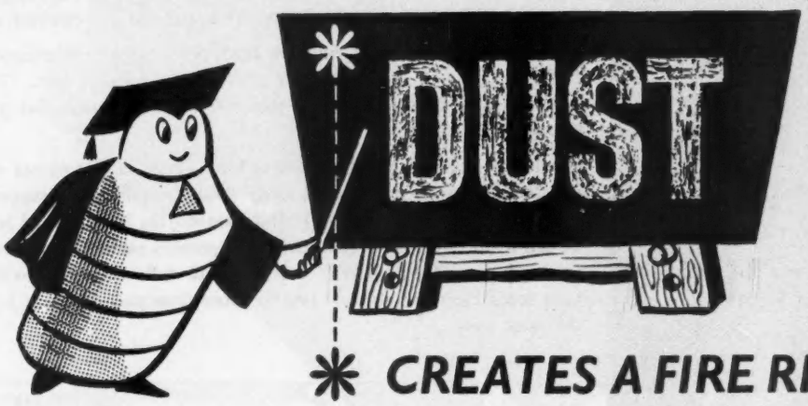


BULAWAYO POWER STATION



CLYDE'S MILL POWER STATION

YARROW AND COMPANY LIMITED · SCOTSTOUN · GLASGOW W4

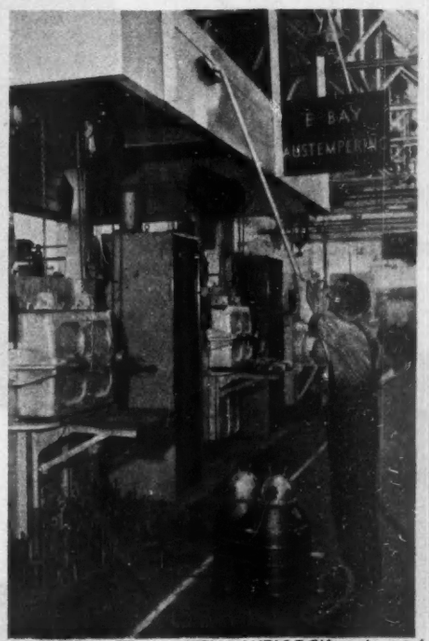


THE MASTER CLEANER

* CREATES A FIRE RISK

The greatest enemy of efficient production—DUST, whether it is creating a fire risk, damaging machinery, blanketing heat and light, jeopardising health, ruining paint or causing extra labour can, unknown to you, gradually whittle down your profits. You cannot SEE the NEED—but it is there all the same, and can be eradicated by NEW WELBECK industrial suction cleaners—the most advanced and efficient machine on the market today. Your premises need NEW WELBECK to restore lost profits.

Write now for further information to Section P34. WE SERVE THE LEADERS OF INDUSTRY.



ROLLS ROYCE use NEW WELBECK industrial suction cleaners. The 'DUPLEX' model cleaner in use at the ROLLS ROYCE Works, Derby.

By appointment to H.M. The Queen Suppliers of Vacuum Cleaners

NEW WELBECK LTD.

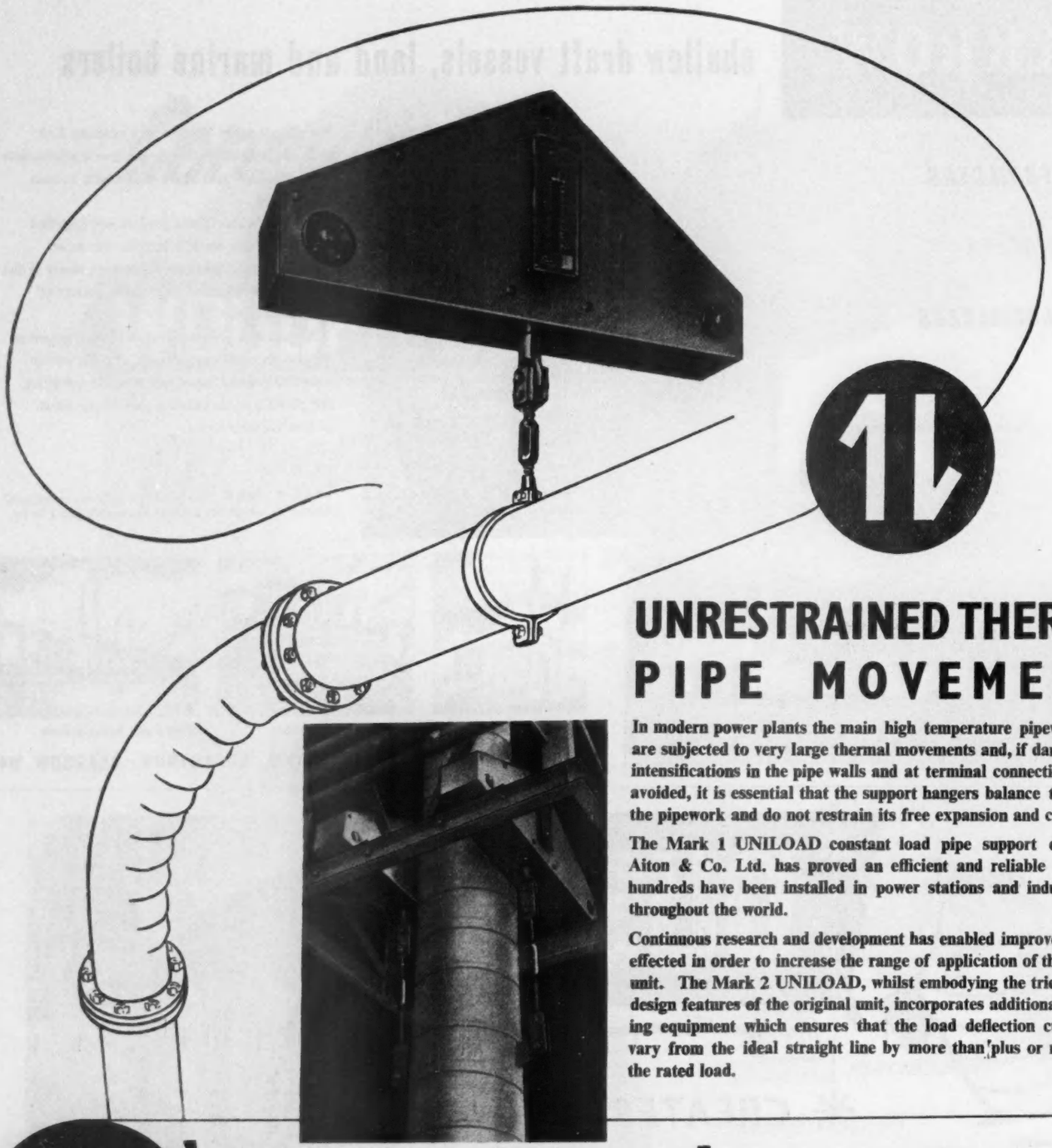
HEAD OFFICE & WORKS:
Moulsecoomb Way, Brighton, 7, Sussex
Tel.: Brighton 61666 (PBX)

LONDON OFFICE:
6 Cavendish Square, London, W.1
Tel.: LANgham 1517 (PBX)

BRANCHES AT BIRMINGHAM, MANCHESTER, SCOTLAND & EIRE

N24

M



UNRESTRAINED THERMAL PIPE MOVEMENTS

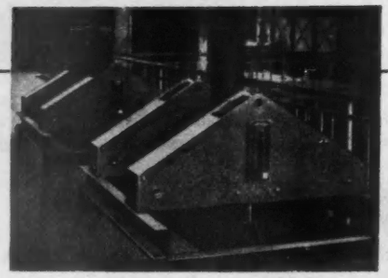
In modern power plants the main high temperature pipework systems are subjected to very large thermal movements and, if dangerous stress intensifications in the pipe walls and at terminal connections are to be avoided, it is essential that the support hangers balance the weight of the pipework and do not restrain its free expansion and contraction.

The Mark 1 UNILOAD constant load pipe support developed by Aiton & Co. Ltd. has proved an efficient and reliable unit. Many hundreds have been installed in power stations and industrial plants throughout the world.

Continuous research and development has enabled improvements to be effected in order to increase the range of application of this supporting unit. The Mark 2 UNILOAD, whilst embodying the tried and proved design features of the original unit, incorporates additional compensating equipment which ensures that the load deflection curve will not vary from the ideal straight line by more than plus or minus 2% of the rated load.

'UNILOAD' CONSTANT LOAD PIPE SUPPORTS

MARK 1 AND MARK 2



The Mark 2 UNILOAD is particularly suited to nuclear power plant or for any application where exceptional accuracy in load carrying characteristics are demanded.

For over 50 years Aiton & Co. Ltd. have specialised in the design, manufacture and installation of **Pipework and Ancillary Equipment** *for the highest temperatures and pressures.*

AITON & CO. LTD.
DERBY
ESTABLISHED 1900

HEAD OFFICE · DERBY · · WORKS · DERBY & SUNDERLAND
TELEPHONE DERBY 44271 (6 LINES) TELEGRAMS CHANNELED DERBY

75 Years of Progress

...in HIGH PRECISION HYDRAULICS

Horizontal Hydraulic Pressure Pump
60 H.P. Three Throw

Enclosed type Horizontal Electrically Driven Three-Throw Hydraulic Pressure Pump with forced lubrication and totally enclosed crankshaft, connecting rods, crossheads and gearing. The speed reduction is obtained by a totally enclosed worm reduction unit.

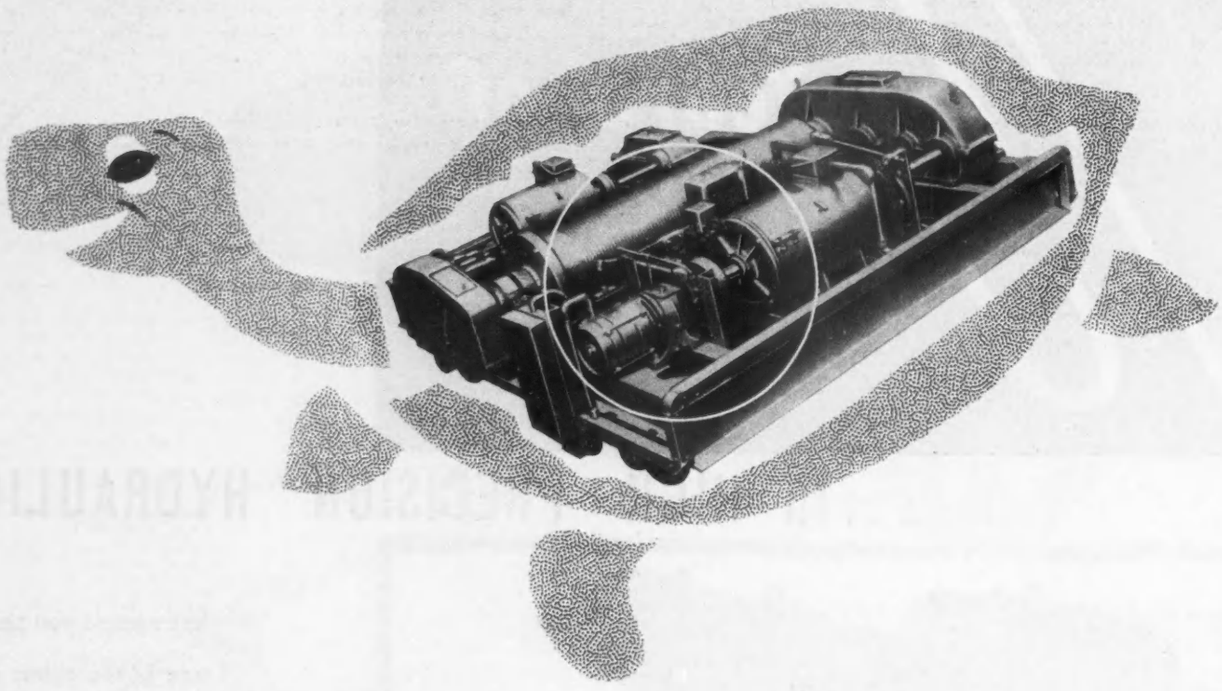
We remind you that we are one of the oldest Hydraulic Manufacturing Companies in Britain and we make all the most modern equipment for every branch of British Industry. Engineering and industrial undertakings of repute in Britain and beyond the seas are our customers.

We also manufacture :—
Hydraulic Spring-Testing Machines, Hydraulic Spring Plate Forming and Cambering Machines, Hydraulic Presses, Pneumatic Spring Scragging Machines, Accumulators, Pumps, Valves and Intensifiers, Plate Bending Rolls, Punching and Shearing Machines.

HENRY BERRY & Co. Ltd.

CROYDON WORKS, LEEDS 10, ENGLAND · *Tel :* Leeds 75481-2 *Telegrams :* RIVETTER, LEEDS 10

slowly but surely . . .



Slomax Creep-Speed Control

This system was developed to meet the need for a controlled creeping speed for all motions of cranes on A.C. supply where precise slow-speeds are required.

The success of this well-tried system, proved under arduous conditions, lies in its extreme simplicity.

The device is entirely automatic and fool-proof.

The main motor is not energised when the creeping speed is in operation.

The operating circuits being electrically inter-locked, it is impossible for the main motor and the Slomax motor to operate simultaneously.

Slomax control permits an unlimited ratio between creeping and normal speeds, and whilst ten to one is usual, a ratio of fifty to one is not uncommon for specialised duties.

A further advantage is that where precise creeping speeds are required for specialised operations, the Slomax control will ensure a predetermined creeping speed, irrespective of the load on the hook.

THE WHARTON CRANE & HOIST CO. LTD.

REDDISH STOCKPORT ENGLAND

Phone : Heaton Moor 2227. Grams : "Gallant, Manchester." Code : Western Union

LONDON: Lincoln House, 296/302 High Holborn W.C.I.	Phone: Chancery 7911.	Grams: Chancery 7911.
SCOTLAND: Fisher-Baxter & Co., 140 West George Street, Glasgow C.2.	Phone: Douglas 1061-2-3.	Grams: Fluorspar, Glasgow.
MIDLANDS: A. R. Holland & Son, 89 Cornwall Street, Birmingham 3.	Phone: Central 1457.	Grams: Central 1457, Birmingham.
SOUTH-WEST: R. C. Collins, 48 Westbourne Road, Penarth, Glamorgan.	Phone: Penarth 1527.	Grams: Penarth 1527.
NORTHERN COUNTIES: Fisher-Baxter & Co., 140 West George Street, Glasgow C. 2.	Phone: Douglas 1061-2-3.	Grams: Fluorspar, Glasgow.
NORTHERN IRELAND: General Engineering Products Ltd., 7/9 Great Patrick Street, Belfast.	Phone: Belfast 23743.	Grams: Belfast 23743.
EIRE or SOUTHERN IRELAND: Charles Nolan & Co., 2 Parker Hill, Lower Rathmines Road, Dublin.	Phone: Dublin 93510.	Grams: Dublin 93510.
CANADA: Marshall Equipment Co. Inc., P.O. Box 28, 61 Victoria Avenue, Dorval Station, P.Q.	Phone: Melrose 1-3528.	Grams: Marquipco, Montreal.

REPRESENTED IN PRINCIPAL COUNTRIES THROUGHOUT THE WORLD.

W.1

CLASSIFIED ADVERTISEMENTS

AGENCIES • DIRECTORS • PARTNERSHIPS • SITUATIONS VACANT • EDUCATIONAL PATENTS BUSINESS OPPORTUNITIES • MISCELLANEOUS • PUBLIC APPOINTMENTS BUSINESSES and PREMISES • TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, *e.g.*, ¼-page £25 10s. ½-page £48. Full page £90.

AUCTION SALES • FOR HIRE • MACHINERY, etc., WANTED • SITUATIONS WANTED DRAWING AND DESIGN SERVICES • FOR SALE • SUB-CONTRACTING

Lineage Rate. 3/6 per line of approximately 6 words. Minimum 14/-.

Inch Rate. 42/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, *e.g.*, ¼-page £22. ½-page £41 10s. Full page £78.

Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/-, which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-Displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

Advertisements for publication should be addressed to:— **Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565.

PUBLIC APPOINTMENTS

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

Principal: G. S. ATKINSON, B.Sc., Ph.D.

APPOINTMENTS

Applications are invited for the following posts, duties to commence as soon as possible.

MECHANICAL AND ELECTRICAL ENGINEERING

(1) SENIOR LECTURER IN MECHANICAL ENGINEERING, to teach to Final Degree standard.

(2) LECTURER IN ELECTRICAL ENGINEERING, to teach to I.E.E. Part III level.

(3) Grade B IN ELECTRICAL ENGINEERING, to teach to H.N.D. standard.

(4) Grade B IN ELECTRICAL ENGINEERING, to teach H.N.C. or Electrical Installation Classes.

(5) Grade B IN MECHANICAL ENGINEERING, to teach to H.N.D. level.

CIVIL AND STRUCTURAL ENGINEERING AND BUILDING

(6) Grade B, to teach Engineering or Building Subjects to H.N.C. level.

Salary scales :—
Lecturer: £1200 by £50 to £1350.
Grade B: £650 by £25 to £1025.

For Grade A and B posts, increments are payable for industrial experience up to 12 years and also additions going beyond the maximum for graduate status and extended training.

Application form and further particulars may be obtained from the Director of Education, Education Offices, Woodlands Road, Middlesbrough. Closing date, 27th January, 1958. E9744

COUNTY BOROUGH OF SOUTHEND-ON-SEA EDUCATION COMMITTEE

MUNICIPAL COLLEGE

Principal:
T. L. MORGAN, M.Sc., A.M.I.C.E., A.M.I.Struct.E.

APPOINTMENTS

Applications are invited for the following posts :—

(a) SENIOR LECTURER IN ELECTRICAL ENGINEERING, to teach Higher and Post Higher National Certificate work.

(b) ASSISTANT, GRADE B, to teach mainly subjects of the City and Guilds of London Institute Radio Servicing Courses, including Television Servicing.

(c) STUDIO MASTER in the School of Architecture (Assistant, Grade B).

Further particulars and forms of application may be obtained from the undersigned (s.a.e. foolscap).

Completed forms should be returned to the Principal, Municipal College, Victoria Circus, Southend-on-Sea, within fourteen days of the appearance of this advertisement.

D. B. BARTLETT,
Chief Education Officer.

Education Office,
Warrior Square,
Southend-on-Sea. E9736

WELSH COLLEGE OF ADVANCED TECHNOLOGY

CARDIFF

Principal: A. HARVEY, Ph.D., B.Sc., F.Inst.P.

DEPARTMENT OF ELECTRICAL ENGINEERING

LECTURERS

Applications are invited for TWO posts as LECTURER on the salary scale £1200 by £30 to £1350 p.a. Candidates should possess a University Degree, together with teaching and industrial experience. Preference will be given to candidates qualified to teach in the field of Electrical Power.

Forms of application, together with further particulars, may be obtained from the Principal, Welsh College of Advanced Technology, Cathays Park, Cardiff.

ROBERT E. PRESSWOOD,
Clerk to the Governors
and Director of Education.

December, 1957. E9732

PUBLIC APPOINTMENTS

ROYAL AIRCRAFT ESTABLISHMENT TECHNICAL COLLEGE, FARNBOROUGH, HANTS

LECTURERS

Applications are invited for the following vacancies in the above selective College :

Post 1 : LECTURER IN AIRCRAFT STRUCTURES.

Post 2 : LECTURER IN ENGINEERING DESIGN.

Candidates should hold University Degrees or equivalent, and preferably have some industrial and/or teaching experience. Candidates for Post 1 should be capable of accepting the responsibility for the teaching of the subject for the final B.Sc. (Eng.) London University, Higher National Certificate, A.F.R.Ae.S., and possibly Diploma in Technology. Candidates for Post 2 should be capable of developing, organising and teaching the subject throughout the College. A new Higher National Certificate scheme is being devised to train design engineers. A suitable successful candidate for either of the above posts may be invited to accept the additional duties of O.C. College Experimental Flight Testing Training, for which a special additional allowance may be paid. Successful candidates will be invited to commence duties as soon as possible.

The salaries payable are in accordance with the Burnham Scale for Teachers in Technical Colleges and are subject to the Teachers' Superannuation Acts. Commencing salary in accordance with experience, on scale £1200 by £30 to £1350.

Details and application forms from the Principal of College, to whom completed forms should be returned. E9616

LONDON COUNTY COUNCIL WESTMINSTER TECHNICAL COLLEGE

PRINCIPAL

Applications are invited for the position of PRINCIPAL of the London County Council Westminster Technical College, Vincent Square, S.W.1, to commence duties in April, 1958. The College offers courses in Civil, Mechanical and Gas Engineering and in Hotel Cookery and Hotel Operation. Extensions to the College are under construction. Applicants should be Graduate Engineers. Professional or industrial experience would be an advantage in addition to the teaching and organising experience necessary to administer a well-equipped College. The salary scale is £1975 by £75 to £2200, plus London allowance under the Burnham (Further Education) Report, 1956.—Further particulars and application forms (stamped, addressed, foolscap envelope) from the Education Officer (F.E.3), County Hall, London, S.E.1, returnable by 25th January. (2339.) E9726

QUEEN MARY COLLEGE (UNIVERSITY OF LONDON)

MILE END ROAD, E.1

ENGINEERING DRAUGHTSMAN (MECHANICAL)

ENGINEERING DRAUGHTSMAN (MECHANICAL), Queen Mary College (University of London), Mile End Road, E.1, experience in design and layout of engineering laboratory apparatus an advantage. Salary placing in range £750–£900 p.a., according to qualifications. Five-day week, four weeks' annual leave, pension scheme.—Letters to Registrar (CMD), stating age, education, details of past and present experience. E9669

LONDON COUNTY COUNCIL

BRIXTON SCHOOL OF BUILDING

LECTURER

Brixton School of Building, as soon as possible, LECTURER IN CIVIL ENGINEERING. Should be an Engineering Graduate of a British University and Corporate Member of an appropriate body, preferably with experience of structural engineering. Teaching or research experience desirable. Burnham F.E. salary scale, £1200 by £30 to £1350, plus London allowance of either £36 or £48 p.a.—Application forms from Secretary at School, Ferndale Road, S.W.4, to be returned by 25th January, 1958. (2260.) E9725

PUBLIC APPOINTMENTS

DERBY AND DISTRICT COLLEGE OF TECHNOLOGY

Principal: T. HEAP, Ph.D., M.Sc., F.R.I.C., A.M.I.I.A.

ASSISTANT, GRADE B, IN CIVIL ENGINEERING

Applications are invited for the post of ASSISTANT, Grade B, IN CIVIL ENGINEERING. The successful candidate will be required to teach Theory of Structures and Surveying and Levelling to the standard of the Final Professional and Higher National Certificate (Civil Engineering) examinations. Candidates should be Graduates in Engineering of a British University or have equivalent professional qualifications. Duties to commence as soon as possible.

Salary in accordance with the Burnham Further Education Scales for Assistants, Grade B—£650 per annum by £25 to £1025 per annum, with additional allowances for Degree (£75, or for 1st or 2nd class Honours £125) and approved training, and up to 12 increments for approved industrial experience.

Forms of application and details of the post may be obtained from the Principal, Derby and District College of Technology, Normanton Road, Derby, by whom completed applications should be received not later than two weeks after the appearance of this advertisement.

C. MIDDLETON,
E9754 Secretary to the Joint Committee.

OXFORD COLLEGE OF TECHNOLOGY, ART AND COMMERCE

ASSISTANT, GRADE "B"

Applications are invited for the post of ASSISTANT, Grade "B," to teach Mechanical and Machine Shop Engineering subjects in the O.N.C. and C.G.L.I. Courses. Applicants should hold a Graduate qualification or its equivalent and have had good industrial experience. Some teaching experience would be an added recommendation.

Duties to commence as soon as possible. Salary in accordance with the Burnham Technical Scale (i.e. from £650 by annual increments of £25 to £1025 per annum), with additions for appropriate training and Graduate qualification; industrial experience after 21 will be recognised in fixing the starting salary.

Forms of application and further particulars from the Principal of the College, Cowley Road, Oxford, to whom applications should be returned before the 31st January, 1958. E9767

THE UNIVERSITY OF LIVERPOOL

LEVERHULME POSTGRADUATE FELLOWSHIPS

Applications are invited for THREE LEVERHULME POSTGRADUATE FELLOWSHIPS, two in the Faculty of Science and one in the Faculty of Engineering, tenable for one year at a value of £500 and renewable for a second year at a value of £550.

Applications, three copies, stating age, details of qualifications and experience, publications, research work in progress and completed, and an outline of the proposed field of research, together with the names of two referees, should be received not later than 1st March, 1958, by the Registrar, from whom further particulars may be obtained. E9768

SURREY EDUCATION COMMITTEE

WIMBLEDON TECHNICAL COLLEGE,
GLADSTONE ROAD, S.W.19

GRADE "B" ASSISTANT

Grade "B" ASSISTANT required, April, 1958, to teach Mechanical Engineering subjects to Ordinary National Certificate level, with Science and Calculations to Final Machine Shop Engineering standard. Preference given to Graduates or equivalent. Salary, Burnham Scale, £650 by £25 to £1025, plus London Allowance.

Application form and further particulars obtainable from the Principal, to whom completed applications should be sent within two week of date of advertisement. E9789

PUBLIC APPOINTMENTS

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY LONDON

ST. JOHN STREET, E.C.1

CIVIL AND MECHANICAL ENGINEERING DEPARTMENT

LECTURERS

Applications are invited for the following appointments, to commence as soon as possible :—

(a) LECTURERS in MECHANICAL ENGINEERING or CIVIL ENGINEERING subjects, with particular reference to Mechanics of Machines, Applied Thermodynamics, Strength of Materials or Theory of Structures.

Applicants should be qualified to teach to the standard of the London Degree in Engineering, Diplomas in Technology or Higher National Certificates.

Scale: £1236, rising to £1398 p.a.

(b) ASSISTANT LECTURERS (Grade B), for the earlier years of the above courses and to assist in other classes; one required mainly for Engineering Drawing.

Scale: £686, rising to £1073 p.a., with considerable additions for qualifications, training and industrial or teaching experience.

Further particulars and forms of application are obtainable from the Secretary,

J. S. TAIT,
Ph.D., B.Sc. (Eng.), M.I.E.E.,
E9653 Principal.

EAST HAM COUNTY BOROUGH

EAST HAM TECHNICAL COLLEGE

ASSISTANT, GRADE "B"

Required, ASSISTANT, Grade "B" in the Engineering Department, to teach Fabrication of Steelwork and Welding subjects. Ability to teach Engineering Science would be an advantage.

Salary scale: £650 by £25 to £1025, with additions for approved training, Degree and London Allowance of £36 or £48. Allowance made for industrial experience in fixing commencing salary.

Forms of application (returnable within 14 days) and further particulars, from the Chief Education Officer, Town Hall Annexe, Barking Road, East Ham, E.6. E9804

NORTH EAST DERBYSHIRE JOINT WATER COMMITTEE

ASSISTANT ENGINEER

Applications are invited for the above appointment at a salary in accordance with Grade III of the A.P.T. Division of the National Salary Scales (£845–£1025). The commencing salary will be determined in accordance with qualifications and experience.

Applicants must be University Graduates or Graduates of the Institution of Civil Engineers, with at least five years' experience.

This appointment offers good experience in the design and construction of treatment plants, &c.

The appointment will be subject to :

(a) N.J.C. Conditions of Service.

(b) Local Government Superannuation Act, 1937.

The successful applicant will be required to pass a medical examination.

The Committee will endeavour to assist in the provision of housing accommodation.

An essential user car allowance will be paid for a Class I car in accordance with the National Scales.

Applications, stating age, experience, qualifications and appointments held, together with the names of two referees, should be submitted to the undersigned not later than Monday, 20th January, 1958.

H. O. HAWKINS,
Clerk.

Rural Council House,
Saltergate,
Chesterfield. E9694

GOVERNMENT OF IRAQ

DEVELOPMENT BOARD AND MINISTRY OF DEVELOPMENT

CHIEF MECHANICAL AND ELECTRICAL ENGINEER

Applications are invited from suitably qualified persons for the post of CHIEF MECHANICAL AND ELECTRICAL ENGINEER for Large Public Buildings in Baghdad.

Further particulars may be obtained from the Commercial Attaché, Royal Iraqi Embassy, 21, Queen's Gate, London, S.W.7, to whom written application should be made. E9782

Classified Advts. continued on page 110

PUBLIC APPOINTMENTS

DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES, AUSTRALIA

CIVIL ENGINEERS

Applications are invited from Graduates (or Undergraduates in their final year) in Civil Engineering of a recognised British or Irish University, for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges or on main road construction and maintenance, either in the metropolitan area or the country.

Commencing salary according to qualifications and experience will be within the range £A1090 to £A1343 per annum, with annual progression, subject to technical competence, to £A1629 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to satisfactory medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the Agent General for New South Wales, 56, Strand, London, W.C.2. E9748

NATIONAL COAL BOARD

SOUTH WESTERN DIVISION

ASSISTANT DIVISIONAL CONTRACTS OFFICER

The National Coal Board require an ASSISTANT DIVISIONAL CONTRACTS OFFICER in their South Western Division.

The successful applicant will be responsible for the commercial aspect of contracting, involving erection or services on site (e.g., building and civil engineering work, major mechanical and electrical engineering work, coal preparation plant), and will be required to negotiate and let contracts of this nature. He will also be responsible for co-ordinating the detailed administration of contracts by the various Areas in this Division. Applicants must have a wide experience in the contracting and commercial fields and be able to represent the Department in both technical and commercial discussions with all Departments of the Board.

A qualification in Civil, Mechanical or Electrical Engineering would be an advantage, as would also a knowledge of the Mining Industry.

Salary range : £1360 to £1925 per annum.

Please quote Staff Vacancy No. 558.

Full particulars of age, qualifications, experience and positions held, together with details of present post and salary, should be sent to the Divisional Chief Staff Officer, National Coal Board, Cambrian Buildings, Mount Stuart Square, Cardiff, by 23rd January, 1958. E9757

EAST ANGLIAN REGIONAL HOSPITAL BOARD

ASSISTANT ENGINEERS

SENIOR ASSISTANT ENGINEER.—Candidates should be Corporate Members of Institution of Mechanical Engineers or have been professionally graded in National Health Service at January, 1953. Must be capable of designing, drafting specifications and working drawings, and supervision of contracts for mechanical engineering services within hospitals, comprising heating, ventilation, hot and cold water services, steam boiler plant, laundries, kitchens, &c. Experience in surveying and reporting upon existing installations desirable. Control and supervision of junior staff. Salary : £1010–£1195.

ASSISTANT ENGINEERS (MECHANICAL).—Candidates should be A.M.I.H.V.E. or Graduate Members of I.H.V.E., or equivalent. Experience in design and installation of heating, ventilating, steam boiler plant and services, &c., as applicable to hospitals desirable but not essential. Salary : £700–£1015—additional increments within scale based on experience and age may be granted.

Applications, stating age, qualifications, experience and details of present position (salary, &c.), with names of two referees, to Secretary of Board, 117, Chesterton Road, Cambridge, by 31st January, 1958. E9752

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH LABORATORIES, LEATHERHEAD, SURREY

ASSISTANT ENGINEERS

ASSISTANT ENGINEERS required to work on a wide range of problems associated with conventional and nuclear power stations. Present investigations concern heat transfer in nuclear fuel elements and heat exchangers, electrostatic precipitators, cooling towers and boiler feed pumps.

Candidates for Second and Third Assistant Engineer vacancies should have an Honours Degree with previous research experience ; for other vacancies a Pass Degree or H.N.C., with appropriate experience, would be acceptable, but importance is attached to ability to apply fundamental knowledge to a wide range of problems.

Salaries according to ability : Second Assistant, £1160–£1510 per annum ; Third Assistant, £1055–£1265 per annum ; Fourth Assistant, £820–£995 per annum ; General Assistant, £550–£725 per annum.

Application forms from S. S. Scott, Chief Personnel Officer, Central Electricity Generating Board, 24–30, Holborn, London, E.C.1, to be returned by 25th January, 1958. Quote Reference ENR/9A. E9747

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

DOUNREAY WORKS, THURSO, CAITHNESS, SCOTLAND

TECHNICAL FOREMEN

The Operations Branch of the Industrial Group of the United Kingdom Atomic Energy Authority has vacancies at Dounreay Works, Thurso, Caithness, Scotland, for FOREMEN :—

(a) To be responsible to a Principal Foreman for a machine shop engaged mainly in the manufacture of prototype items for research purposes and batch production of a wide variety of general engineering components. This post involves the supervision of precision bench fitters and responsibility for the machine tools in the workshop (Post Ref. 2174) ; or

(b) To supervise a number of skilled and unskilled personnel employed on shift duties throughout the works. These duties include the maintenance, operation and installation of Reactor and Chemical Engineering Plant. The posts entail responsibility for all engineering staff on night shift duty (Post Ref. 2175).

Wide experience in precision machining and bench fitting, together with considerable technical resource, good leadership and planning ability in dealing with a wide variety of engineering problems are essential for post (a).

For post (b) applicants must have considerable experience in maintenance and installation work.

A recognised engineering apprenticeship and supervisory experience are essential for all posts, whilst possession of an appropriate Ordinary National Certificate may be an advantage.

Salary will be assessed according to age, qualifications and experience within the scale £875 (at age 30) to £1050.

Contributory pension scheme.

Housing at Thurso or hostel accommodation may be available.

Substantial assistance towards removal expenses is given in certain cases.

Send postcard for application form, quoting appropriate reference, to Recruitment Officer, U.K.A.E.A., I.G. Hq., Risley, Warrington, Lancashire.

Closing date : 27th January, 1958. E9712

SOUTH WESTERN HOSPITAL, LANDOR ROAD, STOCKWELL, S.W.9

ASSISTANT ENGINEER

Applications are invited for the post of ASSISTANT ENGINEER at this 360-bed hospital. Candidates must have completed an apprenticeship in mechanical engineering (as distinct from a wholly craft apprenticeship), or otherwise have acquired a sound, practical training in mechanical and electrical engineering. Possession of a recognised technical qualification is desirable.

The successful applicant will be required to assist the Engineer-in-Charge at the hospital in the supervision of the engineering, electrical and all maintenance services.

Salary in accordance with the scale £525 by £20 (2) by £25 (2) by £30 (1) to £645 per annum, plus London Weighting Allowance.

Applications in writing to the Secretary, South Western Hospital, giving details of age, qualifications and experience, by 23rd January, 1958. E9753

RUNWELL HOSPITAL, NEAR WICKFORD, ESSEX

SENIOR ENGINEER

SENIOR ENGINEER required. Must hold First Class Certificate of Competency in Marine Engineering, City and Guilds Full Technological Certificate in Plant Engineering (First Class) or approved equivalent qualification.

Health Service Whitley Council conditions ; pensionable. Present salary scale, £700–£835. The Officer is required to occupy the house provided at a reasonable rental.

Applications, quoting two referees, to the Secretary, not later than 18th January, 1958. E9761

HORTON ROAD AND CONEY HILL HOSPITALS

GLOUCESTER

SUPERINTENDENT ENGINEER

SUPERINTENDENT ENGINEER required at the above Hospitals, which comprise two large mental hospitals (1487 beds), 2½ miles apart, and annexes.

Salary and conditions in accordance with Whitley recommendations (£915 by £30 (4) by £35 (1) to £1070).

Applicants should have extensive practical experience of the operation, maintenance and co-ordination of hospital engineering services and should hold an engineering qualification at least to the standard approved by the Ministry of Health.

Application form obtainable from the Group Secretary. E9788

SURREY COUNTY COUNCIL

APPOINTMENTS

Applications invited for following appointments :—

(1) ASSISTANT HEATING ENGINEER, Grade IV, £1025–£1175 p.a., plus £30 p.a. London Allowance. A.M.I.H.V.E. and experience in heating and ventilating installations.

(2) HEATING ENGINEERING ASSISTANT, Grade II, £725–£845 p.a., plus L.A. up to £30 p.a. Preferably with some experience in layout and design of heating and hot water services in buildings.

Full details, present salary and 3 copy testimonials, to County Architect, County Hall, Kingston, as soon as possible. E9679

SOUTH EASTERN GAS BOARD

MECHANICAL ENGINEER

MECHANICAL ENGINEER, Isle of Grain Works, South Eastern Gas Board. The works now under construction will produce Town Gas from petroleum products supplied from the adjacent refinery.

The plant will initially include oil gasification units arranged for automatic cyclic operation and will subsequently include high pressure gasifiers with ancillary tonnage oxygen plant.

The successful applicant will be responsible for mechanical details of plant operation and in collaboration with Engineering Staff of the Refinery for the planning and supervision of major overhauls, inspection and preventive maintenance.

Applicants should have practical and varied experience in maintenance of works plant, preferably have served a recognised engineering apprenticeship and be Corporate Members of the Institution of Mechanical Engineers.

Salary will be within the range of £1155–£1315 per annum, according to qualifications and experience.

Housing accommodation will be available at a reasonable figure for the successful applicant.

Applications in writing, quoting reference V14/877, giving full details, should reach the Personnel Manager, SOUTH EASTERN GAS BOARD, Katharine Street, Croydon, within seven days. E9769

NEW ZEALAND MINISTRY OF WORKS

VACANCIES FOR CIVIL ENGINEERING STAFF

Housing, where essential, will be provided for appointees. Free passages to New Zealand, including families, are included in all cases and financial assistance provided towards the cost of transport of furniture and personal goods. Positions, qualifications desired and commencing salaries are as follows :

(1) CIVIL ENGINEERS

Corporate Membership of the Institution of Civil Engineers, London. Commencing salaries from £895 to £1465 per annum.

(2) ASSISTANT CIVIL ENGINEERS

A University Degree in Civil Engineering which gives exemption from the final Parts I and II of the A.M.I.C.E. examination or an equivalent examination. Commencing salaries from £810 to £1080 per annum.

(3) ENGINEERING ASSISTANTS

Preference will be given to applicants with Higher National Certificate in Engineering (Civil), but applications will be considered from men holding Ordinary National Certificate or a General Certificate of Education where they have had at least 8 years' appropriate experience. Commencing salaries from £810 up to £1080 per annum.

(4) CIVIL ENGINEERING DRAUGHTSMEN

Ordinary or Higher National Certificate or equivalent and at least 3 years' experience at the drawing board, but applicants with G.C.E. will be considered. Commencing salaries from £535 up to £1150 per annum in accordance with experience and qualifications.

Vacancies exist in the design and construction of a number of large hydro-electric developmental schemes and on many other types of civil engineering works.

Applicants must be resident in the United Kingdom or Eire and must be exempt from or have fulfilled their National Service obligations.

Inquiries, mentioning this paper and quoting reference No. B11/30/8, also stating the type and number of position sought, should be addressed to The High Commissioner for New Zealand, 415, Strand, London, W.C.2. Full details of duties, experience desired, and general information on the conditions of employment in the New Zealand Public Service, together with application forms, will then be furnished. Completed application forms should be lodged not later than 10th February. E9731

NATIONAL COAL BOARD

CENTRAL ENGINEERING ESTABLISHMENT, STANHOPE BRETBY, NR. BURTON-ON-TRENT

SENIOR ENGINEER AS DEPUTY DIRECTOR

SENIOR ENGINEER as DEPUTY DIRECTOR of the National Coal Board's Central Engineering Establishment at Stanhope Bretby, near Burton-on-Trent, which is concerned with the design and development of the whole range of mechanical and electrical engineering equipment within the coal mining industry. Duties will include deputising for the Director in all technical matters and liaison with manufacturers. Starting salary according to qualifications and experience, but not less than £2500 per annum.

Applications to National Coal Board, Staff Dept. (X.1026/D), Hobart House, London, S.W.1, before 17th January, 1958. E9763

MERSEY DOCKS AND HARBOUR BOARD

JUNIOR ASSISTANT SUPERINTENDENT ENGINEER

Applications are invited for the position of JUNIOR ASSISTANT SUPERINTENDENT ENGINEER of Dredgers, Hoppers, Floating Cranes, Pilot Boats, &c.

An Extra First Class Ministry of Transport Certificate and experience of ship repair work and diesel engines will be an advantage. Salary, £1000 per annum—age between 30 and 40 years.

Applications should be addressed to the Engineer-in-Chief, Mersey Docks and Harbour Board, and received not later than the 18th January, 1958.

A. S. MOUNTFIELD,
General Manager and Secretary.

Dock Office,
Liverpool, 3. E9778

LIVERPOOL REGIONAL HOSPITAL BOARD

ASSISTANT ENGINEERS

Applications are invited from suitably qualified persons for the following permanent pensionable appointments on the staff of the Regional Engineer :—

(a) TWO ASSISTANT ENGINEERS (MECHANICAL)

Applicants must hold Associate Membership of the Institution of Heating and Ventilating Engineers, and be conversant with the design of heating and ventilation systems in hospitals or buildings and the preparation of estimates, drawings and specifications.

(b) ASSISTANT ENGINEER (ELECTRICAL)

Applicants should have passed the Institution Examination and be Graduate Members of the Institution of Electrical Engineers, be experienced in the preparation of specifications, drawings and estimates for distribution schemes, electrical installations in hospitals and buildings, and be able to take details of existing installations and have a good knowledge of modern installation practice.

Commencing salary for each post within the scale £700–£1015 per annum, dependent on age and previous relevant practical experience.

Applications, stating age, qualifications, experience, present and previous appointments, with names and addresses of three referees (two technical), stating the post applied for, to reach me at 19, James Street, Liverpool, 2, not later than 25th January, 1958.

VINCENT COLLINGE,
E9647 Secretary to the Board.

FEDERATION OF RHODESIA AND NYASALAND

DEPARTMENT OF CONSERVATION AND EXTENSION, NORTHERN RHODESIA

MECHANICAL ENGINEER

Applicants must hold a recognised Degree in Mechanical Engineering, and/or be a Corporate Member of the Institution of Mechanical Engineers, and should have experience in workshop and field organisation of plant and equipment. Experience in works costing and stores control will be an added recommendation.

Duties will include the organisation and control of the Department's fleet of heavy crawler tractors, ancillary equipment and vehicles, as well as the workshops and stores. He will also be required to give advice on mechanical matters.

Salary : £1700 per annum, on scale rising to £1850. Government housing will be provided at rental of 12½ per cent of basic salary. If the successful applicant is married, he will receive an allowance of £80 per annum while serving in Northern Rhodesia.

Application forms and further information from Secretary (R), Rhodesia House, 429, Strand, London, W.C.2. Closing date : February 8. E9765

COUNTY BOROUGH OF BIRKENHEAD

WATER DEPARTMENT

SENIOR ASSISTANT ENGINEER

Applications are invited for the appointment of SENIOR ASSISTANT ENGINEER—salary A.P.T. Grade III (£845–£1025).

Candidates should have suitable experience in Waterworks.

Form of application and details obtainable from Mr. W. K. Lewis, B.Sc., M.I.C.E., Water Engineer, 601, Borough Road, Birkenhead.

Closing date for applications, 27th January, 1958.

Relationship with Members or Senior Officers of the Council must be disclosed.

DONALD P. HEATH,
Town Clerk.
Town Hall,
Birkenhead. E9717

CITY OF PLYMOUTH

SENIOR ENGINEER, GRADE "B"

Appointment of Special Staff for Bridge Design and Construction.

Applications are invited for the following appointment :

SENIOR ENGINEER, Grade "B" (at present £1235–£1405) for the Design and the Construction of the proposed new Laira Bridge, a 500ft.-long dual carriageway crossing of tidal waters with deep foundations.

Applicants should be qualified Civil or Structural Engineers with experience in R.C. and prestressed concrete design, and also in deep sub-aqueous foundations.

It is anticipated that the appointment will, subject to satisfactory service, be for a period of 4 years, the first part of which will be on the design, preparation of contract documents and the remainder of the time as Resident Engineer.

Age limit 40, or 45, if already serving with a Local Authority. Position is subject to a medical examination and pensionable. Housing may be made available and part of removal expenses refunded. Application returnable by 25th January, 1958, on forms obtainable from me.

J. PATON WATSON, C.B.E., M.I.C.E.,
City Engineer and Surveyor.

The Guildhall,
Plymouth. E9719

REPUBLIC OF LIBERIA

DISTRIBUTION ENGINEER

Liberia (West Africa).—DISTRIBUTION ENGINEER wanted. Age 25–35, with experience in erection, maintenance of overhead and underground systems, air and oil circuit breakers and modern protection systems. Transportation and housing free and leave pay with first-class passage.

Contact Liberian Consulate General, 13, New Burlington Street, W.1, for details. E9793

PUBLIC APPOINTMENTS

CENTRAL ELECTRICITY GENERATING BOARD

SOUTH EASTERN DIVISION

APPOINTMENTS

(a) BRIGHTON "A" POWER STATION
GENERAL ASSISTANT ENGINEER (CONTROL).—Applicants should have knowledge and preferably experience of Turbo-generators and of Control Room duties.
Salary class H, Grade 13, £685–£730 per annum, plus 10 per cent. Shift Allowance.
(b) BRIGHTON "B" POWER STATION SITE CONSTRUCTION
THIRD ASSISTANT ENGINEER (MECHANICAL).—The successful applicant will be required to assist in the supervision of Contractors engaged on the erection of boilers, turbo-alternators and ancillary plant.
It is preferable that candidates should have had previous experience in either the manufacture or erection of Power Station Plant.
Salary class AX/DX, Grade 6, £895–£1110 per annum.
(c) LITTLEBROOK POWER STATION
ASSISTANT ENGINEER (EFFICIENCY).—Candidates should possess technical qualifications at least to H.N.C. standard, and practical experience in Generating Station work would be an advantage. The successful applicant will be required to assist the Station Efficiency Engineer in investigation into the thermal performance of the plant and will be required to work independently and to take the initiative in solving problems which arise.
Salary class L, Grade 14, £830–£885 per annum, including London Allowance.
(d) BRIGHTON TRANSMISSION DISTRICT
THIRD ASSISTANT ENGINEER (TRANSMISSION).—Applicants should preferably possess H.N.C. in Electrical Engineering or equivalent qualifications, and have experience in the operation and maintenance of overhead lines, transformers and switchgear up to 275kV. Experience in control of labour is essential.
Salary class AX/DX, Grade 6, £895–£1110 per annum.
(e) KINGSTON "B" POWER STATION
GENERAL ASSISTANT ENGINEER (EFFICIENCY).—The successful applicant will assist in plant testing and the maintenance of efficiency records. This position offers excellent opportunities for obtaining Power Station experience.
Salary class G, Grade 14, £630–£675 per annum, including London Allowance.
Applications, giving details of education, age, present position, experience, &c., should be sent according to location of vacancy, i.e. (a) Station Superintendent, Brighton "B" Power Station, Portslade by Sea, Sussex; (b), (d) Establishments Officer, Lower Ham Road, Kingston-upon-Thames, Surrey; (c) Station Superintendent, Littlebrook Power Station, Nr. Dartford, Kent; (e) Station Superintendent, Kingston "B" Power Station, Downhall Road, Kingston-upon-Thames, Surrey, so as to arrive by 17th January, 1958, quoting reference 208. E9802

ATOMIC ENERGY RESEARCH ESTABLISHMENT

HARWELL

APPOINTMENTS

ELECTRICAL/ELECTRO-MECHANICAL DESIGN (Ref. 1011Y/25)
A professionally qualified ENGINEER is required in a section providing a design manufacturing and commissioning service to Research Divisions, to prepare basic designs and supervise all stages of production (including control and technical guidance of the section).
Salary: £1300–£1740 (Engineer II).
Housing, superannuation and excellent conditions.
APPLIED MATHEMATICIANS (Ref. 990Z/25).
Required to study Kinetics and Control Problems of advanced types of Reactor Systems, using large, modern computers.
Appointments will be in the Scientific Officer class (requiring good Honours Degree or equivalent), at salaries between £645 and £1425, or if professionally qualified in the Engineer class—£815–£1740.
Nuclear experience not essential but knowledge of heat transfer, hydrodynamics, neutron kinetics, analogue or digital computers, desirable.
Send postcard, quoting appropriate reference, to Recruitment Officer, A.E.R.E., Didcot, Berks., for application form and details. E9730

ROYAL NAVAL SCIENTIFIC SERVICE

APPOINTMENTS

Royal Naval Scientific Service requires PHYSICISTS, ELECTRONIC ENGINEERS and MATHEMATICIANS for 25 Senior Scientific and Scientific Officer posts at establishments in London area, Baldock, Harwell, Haslemere, Poole, Greenock and Rosyth. Also required: MECHANICAL ENGINEER for work on heat transfer problems at Harwell. MECHANICAL ENGINEER for work on fuel and lubricating oil problems in London area. MECHANICAL ENGINEER for work on gas turbine and problems in London area. CHEMICAL ENGINEERS for London area and Poole. METALLURGISTS for Rosyth and Poole. CHEMISTS (Physical and Inorganic) for Poole and Baldock. Candidates must normally be natural born British subjects of natural born British parents, with at least First or Second Class Honours Degrees or equivalent high professional attainments. S.S.Os. must have had at least three years' post-graduate experience and be 26 years of age.
Salaries: (men) S.S.O. £1190–£1410; S.O. 635–£1110 (London)—somewhat lower in provinces. Appointments are unestablished (with F.S.S.U. benefits) but opportunities may occur for those under 32 to compete for established posts.
Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting A.363/7A. E9764

TENDERS

CITY OF BAGHDAD

BAGHDAD SEWERAGE BOARD

BAGHDAD DRAINAGE—CONTRACTS IA, ID AND IC

TO CIVIL ENGINEERING CONTRACTORS.
THE BAGHDAD SEWERAGE BOARD invites TENDERS for the CONSTRUCTION of the CIVIL ENGINEERING WORKS of the FIRST STAGE of the BAGHDAD SEWERAGE SCHEME.
The works to be constructed comprise three Contracts and Contractors may submit Tenders for any one, any two, or all three of the individual Contracts. The conditions of contract, specification, bills of quantities, form of Tender, &c., for all three Contracts are contained in the same Tender document.
The works to be constructed in the individual Contracts are :—
CONTRACT IA.—The first stage of the Soiada Sewage Treatment Works for a population of 300,000 persons and including pumping stations, settlement tanks, channels, outfall, sludge digestion tanks, power house and ancillary works.
CONTRACT IB.—Approximately 11km. of Trunk Sewer between 1·85m. and 2·3m. diameter, 14 Sewage Pumping Stations and short lengths of 0·6m. and 0·75m. diameter Sewers and Associated Pumping Mains.
CONTRACT IC.—Approximately 170km. of Pipe Sewers between 22·5cm. and 45cm. diameter, together with associated Pumping Mains, laterals for house connections and ancillary works. (Note: In certain circumstances Tenders for shorter lengths of sewers and associated works will be considered.)
The Tender document and contract drawings may be inspected during normal working hours after January 6th, 1958, at the offices of the Baghdad Sewerage Board, Baghdad, at the Royal Iraqi Embassies in Rome and Washington, at the Royal Iraqi Legations in Brussels, and Rome, and at the offices of the Consulting Engineers, John Taylor and Sons, Artillery House, Artillery Row, London, S.W.1, and 464, Alwiyah, Baghdad (telephone No.: Baghdad 98736).
Copies of the Tender Document and Contract Drawings may be obtained from any of the abovementioned addresses on payment of ID. 20 (Twenty Iraqi Dinars) or £20 (Twenty Pounds Sterling). This payment will not be returnable and must be made by cheque or Banker's draft, payable to the Consulting Engineers.
The Tenders shall be in English and must be accompanied by a deposit of I.D. 10,000 (Ten Thousand Iraqi Dinars), either in cash or by a letter of guarantee from an approved Bank in Iraq. The Tenders accompanying documents must be enclosed in a sealed package which shall not in any way indicate the name of the Tenderer and must be delivered in Baghdad in accordance with the instructions contained in the document by 12 o'clock noon, local time, on the 1st day of June, 1958.
During the time allowed for Tendering, the Baghdad Sewerage Board reserves the right to amend the documents for the purposes of clarification or modifications in design or contract conditions. Any such amendments will be notified in writing to prospective Tenderers.
The Baghdad Sewerage Board does not bind itself to accept the lowest or any Tender.
FAKHRI AL FAKHRI,
Chairman of the Baghdad Sewerage Board.
E9699

SCOTTISH HOME DEPARTMENT

COUNTY OF ARGYLL
CONNEL-GLENCOE TRUNK ROAD (A828)

KENTALLEN-LURIGNICH-CREAGAN SECTION

CONTRACT NO. A.31

The Secretary of State invites TENDERS for the completion of FIVE SECTIONS (Contract No. A.31) of the CONNEL-GLENCOE TRUNK ROAD, in the County of Argyll; sections are Kentallen, Duror, Dalnatrat, Tynribbie and Creagan. The works together comprise approximately two miles of new or reconstructed road, including a new reinforced concrete arch bridge of 49ft. skew span over the Salachan Burn.
The Secretary of State is prepared to consider also Tenders for Certain Sections as Alternatives to a Tender for all Five Sections (Contract No. A.31), i.e. Contract No. A.31A, Kentallen and Duror sections; Contract No. A.31B, Dalnatrat section (which includes the new bridge over Salachan Burn), and Contract No. A.31C, Tynribbie and Creagan sections.
Contract documents, together with any further information required regarding the nature of the work, may be obtained from the Chief Road Engineer, Scottish Home Department, Bankhead Avenue, Sighthill, Edinburgh, 11, upon payment of a deposit of £10 by cheque or draft made payable to the order of the Queen's and Lord Treasurer's Remembrancer. The deposit will be returned if a bona-fide Tender is submitted and not subsequently withdrawn.
Copies of the drawings are available for inspection at the offices of the Scottish Home Department (Roads Division), Glenshellach Road, Oban, Argyll, and at the offices of the Chief Road Engineer, Scottish Home Department, Bankhead Avenue, Sighthill, Edinburgh, 11.
Tenders, on the official form, which must be received before 4 p.m. on Friday, 21st February, 1958, should be sent in a sealed, registered envelope marked "Tender for Roadworks Contract No. A.31," addressed to the Secretary, Scottish Home Department, Broomhouse Drive, Saughton, Edinburgh, 11.
The Secretary of State does not bind himself to accept the lowest or any Tender. E9733

TENDERS

DAMODAR VALLEY CORPORATION

CHEMICAL FEED EQUIPMENT

PLANT

The Office of the Damodar Valley Corporation, Anderson House, Alipore, Calcutta, 27, India, invites TENDERS for the following :—
(1) D.V.C. Tender Enquiry No. PE–SPEC–35, CHEMICAL FEED EQUIPMENT for D.V.C. Durgapur Thermal Power Station and Bokaro Fourth Unit, comprising, in the main, of the following :—
Five High-pressure Chemical Feed Pumps, capacity 0·20 g.p.h., discharge pressure 2000–2500 p.s.i.g.
Five Low-pressure Chemical Feed Pumps, capacity 0·20 g.p.h., discharge pressure 100 p.s.i.g.
Four Chemical Dissolving Tanks of 100 gallons capacity, each with agitators, &c.
(2) D.V.C. Tender Enquiry No. PE–SPEC–36, for SUPPLY of PLANT for Servicing Instruments, Air Compressors, generating at Durgapur Station.
Specifications relative to the above can be purchased direct from the Damodar Valley Corporation of the above address at ten shillings and sixpence and fifteen shillings respectively, plus air parcel charges of £1 17s. 6d. per copy. Tenders are to be returned direct to D.V.C. Calcutta, to reach there on 23rd and 24th January, 1958.
Specimen copies of the above specifications are on view at India Store Department, Government Buildings, Bromyard Avenue, Acton, London, W.3, under references S.2974/57 ENG. 2 and S.2973/57 ENG. 2. E9796

KINGDOM OF THAILAND

ROYAL IRRIGATION DEPARTMENT

The DATE for OPENING BIDS is hereby CHANGED from 10 a.m., Bangkok Standard Time, March 7th, 1958, to 10 a.m., Bangkok Standard Time, April 14th, 1958.
M. L. XUJATI KAMBHU,
Director General,
E1515 Royal Irrigation Department.

EDUCATIONAL

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams., and Technical Divisions from Elementary to Degree standard. Approximately 95 per cent. successes. 144-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E721 E

FREE! Brochure giving details of Courses in Mechanical and Production Engineering, Draughtsmanship, &c., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other professional examinations. —E.M.I. Institutes, Dept. E.30, London, W.4. (Associated with H.M.V.). E972 E

TECHNICAL HOME STUDY COURSES

For A.M.I.Mech.E.,
A.M.I.Chem.E., A.M.I.M.I.,
A.F.R.Ae.S., C. & G., &c.
OVER 50 FIRST PLACES and more than 2000 Passes have been secured by T.I.G.B. Students at Professional Engineering Examinations. We have a wide range of exclusive Home Study Courses in all branches of Engineering—Mechanical, Electrical, Aeronautical, Automobile, Chemical, Gas, Radio, and Television, Draughtsmanship, &c. Textbooks, blueprints, &c., are provided and, if desired, fees may be paid by moderate instalments.—Write (stating subject of interest) for copy of 110-page Prospectus FREE and without obligation.
THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN
(Dept. 76),
29, WRIGHT'S LANE, LONDON, W.8.
E102 E

UNIVERSITY COLLEGE LONDON (Gower Street, W.C.1). An INAUGURAL LECTURE by Professor R. E. D. Bishop, entitled "Applied Mechanics in Engineering," will be given on Thursday, 23rd January, at 5.30 p.m. Admission Free, without ticket.—E. A. L. Gueterbock, Secretary. E9727 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED

APPLICATIONS ARE INVITED by the Steetley Magnesite Co., Ltd. (a member of the Steetley Group of Companies) for the position of WORKS ENGINEER at their substantial and expanding chemical works at Hartlepool, Co. Durham, engaged in the production of refractory magnesia from dolomite and seawater. Exceptional opportunity for capable young man between 30/45 years of age, with sound knowledge of hydraulics, mechanical handling and combustion machinery. Pension and B.U.P.A. facilities provided.—Write, stating age and industrial experience, to the Managing Director, Steetley Magnesite Co., Ltd., Palliser Works, Hartlepool, Co. Durham. E1511 A

ASSISTANT TO CHIEF DRAUGHTSMAN required, to assist in control of medium-sized drawing-offices, engaged on development and maintenance work at large works situated in the Midlands. Experience of heavy engineering and steel plant work preferred. Good opportunity for man with initiative, ability, good technical knowledge, experience and willingness to take responsibility. Five-day week, pension scheme, and good social facilities. Reply, stating age, qualifications and experience,—BOX No. E1509, "The Engineer." A

SITUATIONS VACANT

A PROGRAMMING AND PROGRESSING ENGINEER is required on the Civil Engineering Construction of a Major Steelworks at Durgapur in India. The Contract is for three years, at a salary of £2000 per annum, tax free, with bonus, free medical attention, paid leave, free passages for families and furnished accommodation at a reasonable rent.
Applicants should have had at least 3 years' experience on major projects, either with Consulting Engineers or Contractors.
Apply, giving full personal details and details of qualifications and experience, to :
The Cementation Company, Ltd.,
Du.gapur Project,
20, Albert Embankment,
LONDON, S.E.11. E9746 A

A WELL-KNOWN ORGANISATION with world-wide interests wishes to recruit a young qualified
MECHANICAL ENGINEER
aged 23–30, for appointment as an Assistant Engineer within their Production Division.
The successful applicant will become a member of a management team and should be capable of accepting a high degree of responsibility within 3–4 years. This is an attractive opportunity for the right man. The organisation is expanding and its product is an interesting one.
Reply, stating full details of age, qualifications and experience.—BOX No. E9722, "The Engineer." A

AN ASSISTANT ENGINEER
is required by
KUWAIT OIL COMPANY
for their
LONDON OFFICE
The Company has a vacancy for an Assistant Engineer in the Refinery Department of their London Office.
Candidates for the post must be University Graduates in Mechanical or Chemical Engineering; they should have a sound knowledge of materials, specifications and practices of the petroleum or chemical engineering industries, with previous experience in one of these fields.
Salary will be according to qualifications and experience. Free lunches in Company restaurant; non-contributory pension scheme.—Applicants should write for application form, giving brief details and quoting L.O.243, to BOX T/126, c/o 191, Gresham House, E.C.2. E9760 A

AN EXECUTIVE SALES REPRESENTATIVE
is required by a World Wide Organisation in the Building and Engineering industry, dealing with Heating, Air-conditioning and Mechanical Installations.
The successful applicant must have been accustomed to negotiating large-scale contracts with Principals.
Experience and knowledge of this work is therefore essential.
Applications will only be considered from men who are earning
NOT LESS THAN £2000 P.A.
Fullest details of background and previous experience should be addressed, in strictest confidence, to the Managing Director.—BOX No. E9798, "The Engineer." A

AN UNUSUAL OPPORTUNITY FOR APPRENTICE-TRAINED ENGINEER
Advertiser requires a FOREMAN (aged approx. 30–40), of good personality, to take responsibility for Test Site and Workshops in Berkshire. Experience of Rocket Motor Testing is desirable but men with experience of Gas Turbines will be favourably considered. Technical education to at least O.N.C. and preferably H.N.C. in Mechanical Engineering is an essential qualification and previous supervisory experience or training is desirable. This position offers good prospects in a small but expanding division of a large company. Apply, giving fullest details of training, experience, past and present employment and present salary, to Personnel Manager.—BOX No. E9523, "The Engineer." A

BRITISH PETROLEUM COMPANY, LTD., requires an ASSISTANT DEVELOPMENT ENGINEER to work in its Shipping Department on propulsion and ancillary machinery projects for large tanker building programme. Applicants under 35 years of age must have B.Sc. Honours Degree or equivalent and have design office experience in large power machinery work with preferably some marine and sea-going experience. Experience in Applied Thermodynamics and Mechanics essential and applicants must be able to work at the drawing-board. Knowledge of theory and current practice in automatic control techniques, both pneumatic and electronic, desirable. Imagination, adaptability and capacity to apply original thinking on the development of sketch ideas are qualities most necessary for this appointment. Salary according to age, qualifications and experience, non-contributory pension fund, assisted house purchase scheme, removal expenses and settling-in allowance payable in certain cases, luncheon club.—Write, giving full particulars, quoting H.4341, to BOX 5655, c/o 191, Gresham House, E.C.2. E9715 A

Classified Advts. continued on page 112

SITUATIONS VACANT

ASSISTANT WORKS MANAGER for old-established company in Yorkshire, West Riding, manufacturing medium heavy machine tools. Experienced in modern production methods and capable of controlling labour force of approximately 200. Preferred age 28/32, minimum qualifications H.N.C. Commencing salary up to £900 per annum, plus production bonus. Contributory pension scheme and free life assurance. Write in confidence for attention of General Manager, marking envelope "Private and Confidential."—BOX No. E1503, "The Engineer." A

BRITISH PETROLEUM COMPANY, LTD., has vacancies for young MECHANICAL ENGINEERS, for service with its Overseas Exploration Drilling Operations. Applicants up to 26 years old must have O.N.C. in Mechanical Engineering or equivalent, and have served a five-year apprenticeship with a diesel engine manufacturer with experience in fitting, turning and preferably some outside erection work, with subsequent experience in operating and maintaining diesel engines. Experience of steam pumps, engines, boilers and refrigeration advantageous. Attractive salary, plus generous allowance in local currency, free passages out and home, free medical attention, good leave arrangements. Kit allowance, pension scheme.—Write, giving full particulars, quoting F.546, to BOX 3014, c/o 191, Gresham House, E.C.2. E9759 A

BRITISH PETROLEUM COMPANY, LTD., requires a MECHANICAL ENGINEER for service in IRAQ. Applicants, aged 25–30, must hold at least O.N.C. and preferably H.N.C. in Mechanical Engineering, and have served a five-year workshop apprenticeship. Machine and fitting shop experience essential and some knowledge of welding and experience on overhauling pumps and C.I. engines desirable. Some experience of maintenance of launches and barges advantageous. Duties involve supervision of small general workshops, maintenance of rivercraft and oil distribution depot equipment. Attractive salary plus generous allowance in local currency, kit allowance, pension scheme, good leave arrangements, free passages out and home.—Write, giving full details of qualifications and experience, quoting F.549, to BOX 3018, c/o 191, Gresham House, E.C.2. E9758 A

CHEMICAL ENGINEERS.—Interesting work, with opportunities for advancement, exist for those prepared to undertake development projects connected with the introduction of new industrial processes and equipment. Positions offer responsibility and scope for original thinking. Conditions of employment are good with pension scheme, &c., and houses available in New Town. Applicants should have Degree; previous research experience desirable. —Write, stating age, qualifications, experience and salary required, to Personnel Officer, The A.P.V. Co., Ltd., Manor Royal, Crawley, Sussex. E9766 A

CHIEF DRAUGHTSMAN, for small D.O. chemical engineering contracting. Up to £1500. Minimum requirements H.N.C., experience of responsible position and of correspondence. Age 30–40.—Ring, PAD 2666. E1508 A

CHIEF DRAUGHTSMAN required by a large engineering company to take charge of their London design offices, situated in the West End. The successful applicant must have very sound experience of mechanical and/or structural engineering, and be an A.M.I.Mech.E., also able to administrate a staff of 17 men, and negotiate with customers and potential customers.—Please apply, with full particulars, quoting "Director," to BOX No. E9749, "The Engineer." A

CIVIL ENGINEER required by Westminster consulting engineers for work on a variety of projects, which include large concrete bridges. Applicants should preferably be between 26 and 32 years of age and be A.M.I.C.E. The post calls for sound general knowledge of design work and offers good experience with scope for initiative and prospects of advancement.—BOX No. E9780, "The Engineer." A

CONSULTING ENGINEERS, engaged on varied R.C. and steel structural works, general civil engineering work and foundation problems, require capable ASSISTANTS, both for design and for detailing. Five-day week and luncheon vouchers.—Apply, Maurice Nachshen and Partners, 58, Victoria Street, S.W.1. E1510 A

DESIGNER-DRAUGHTSMEN, for structural steelwork, are required. Positions are progressive and salary dependent on experience and ability. Five-day week, canteen and sports club facilities.—Applications to Personnel Manager (ref. SS.D.4), John Laing and Son, Limited, London N.W.7. E9771 A

DESIGNER for Horticultural Machinery, with experience of Lawnmowers and similar machines, required. The position will carry a good salary and participation in pension and life insurance scheme. Apply, giving full particulars of experience, salary expected.—BOX No. E9634, "The Engineer." A

DRAUGHTSMAN required for design office, preferably but not necessarily with experience in the design of hydraulic presses and machines; young man with design ability and imagination preferred. A permanent post with great prospects.—BOX No. E9792, "The Engineer." A

DRAUGHTSMEN required in the following categories: Senior and Junior Piping and Instrumentation; Senior Mechanical, by Engineers in City engaged on nuclear/petroleum/chemical plants, H.N.C./O.N.C. desirable. Salaries above average. 5-day week, pension/life assurance and personal accident schemes, house purchase assistance, luncheon vouchers.—Write full particulars to Head Wrightson Processes, Ltd., 24/26, Baltic Street, E.C.1. E954 A

DRAUGHTSMEN (2), MECHANICAL, required by Morgan Refractories, Ltd., Liverpool Road, Neston, Wirral, for interesting work on major expansion schemes. Must be capable of preparing layout drawings of new plant and subsequent design and detail work. A knowledge of press tools is also desired, but not essential. O.N.C. grade or higher an advantage. Must have served workshop apprenticeship; 5-day week, canteen, sports club, pension scheme.—Application forms from Staff Admin. Asst., or telephone Neston 1406, Ext. 7. E9781 A

ENGINEER, age about 30, with good experience of machine tools, required by old-established East Midlands Machine Tool Reconditioning and Merchant Company, to join Sales Staff. Training will be given. Excellent opportunity. Pension scheme. Apply in writing, stating age, experience and salary required.—BOX No. E1504, "The Engineer." A

EDWARDS HIGH VACUUM, LIMITED, MANOR ROYAL, CRAWLEY, SUSSEX, have vacancies for the following:—

DESIGN DRAUGHTSMEN (2), for the design, detailing and scheduling of special high-vacuum equipment. Applicants (21–28) should preferably have an Ordinary or Higher National Certificate in Mechanical Engineering, and have had both workshop practice and drawing-office experience.

Commencing salary according to age and experience. Housing available if from London area. Permanent pensionable position.—Applications, giving full details of past experience, to the Personnel Manager. E9775 A

ENGINEER (aged 35/40) required to take charge of Engineering Department of large laundry and dry cleaning works. Laundry experience preferable, but an ability to control staff and accept responsibility to the Chief Engineer for maintenance, repair and installation of plant is essential. Excellent working conditions. Pension scheme.—Full particulars, including salary required, to the Personnel Officer, Lakeland Laundries (Barrow), Ltd., Abbey Road, Barrow-in-Furness, Lancs. E1499 A

ENGINEER/MANAGER, to control the location recording, and flow of materials in an important steel warehouse in Central London. Production and/or T.R. experience essential. Able to create efficient procedure and see that it is carried out. Write full details of experience and salary required.—BOX No. E9777, "The Engineer." A

ENGINEER (MECHANICAL).—An insurance company invites applications from Engineers not over 35 years, for position as Lift and Crane Engineer Surveyor in the London area. Applicants should have served an apprenticeship, or equivalent period with lift and crane makers, and have a sound theoretical and practical knowledge of lifts and lifting appliances and their maintenance. Technical qualifications Higher or National Certificate (Mechanical). Progressive salary scale commencing £735, rising to £1060 per annum, plus other expenses and allowances. Non-contributory pension scheme. Apply in own handwriting.—BOX No. E9772, "The Engineer." A

ENGINEER'S DRAUGHTSMAN, Senior or intermediate, preferably with H.N.C., required by The British Drug Houses, Ltd., for layout and development work in a small office attached to a chemical factory. Applicant should be able to deal with projects from site details to working drawings. Five-day week, pension and profit sharing scheme.—Write stating age, experience and salary required, to Staff Manager, Graham Street, N.1 E9675 A

ESTIMATOR for progressive position with prominent London firm of Land and Marine Boiler Engineers. Drawing-office experience essential; workshop experience an advantage. Attractive salary commensurate with experience and qualifications.—Write fully, stating age, &c., BOX No. 1389, c/o Charles Barker and Sons, Ltd., Gateway House, London, E.C.4. E9803 A

EXPERIENCED STRUCTURAL STEELWORK DESIGNER, with a good knowledge of light structures as well as conventional steel design, required by Consulting Engineers. Five-day week.—Apply, stating full details of experience and salary required, to Alan Marshall and Partners, 73/74, High Holborn, W.C.1. E1436 A

FORD MOTOR COMPANY LIMITED
VACANCY FOR WATER ENGINEERING ASSISTANT

There is a vacancy for an Engineer who has held a position with a degree of responsibility with a Waterworks Undertaking. Applicants should be capable of giving sound technical assistance in the maintenance, planning, new design and construction of water supply systems.

Salary in accordance with experience and qualifications. Generous non-contributory pension scheme.—Please write to Training and Recruitment Department (012a), Ford Motor Company Limited, Dagenham, Essex, giving details of age, experience and qualifications, and quoting reference PWE. E9805 A

FOSTER WHEELER, LIMITED,
Marine Boiler Department

ENGINEERS required for design work on new projects and developments. Qualifications should include B.Sc., H.N.C. or A.M.I.Mar.E., while previous experience of heat transfer or pressure-vessel work is preferable. Age range, 25–35 years. Good salary and prospects; pension fund.—Write fully, Staff Manager (MB), Foster Wheeler, Limited, 3, Ixworth Place, London, S.W.3. E9673 A

GRADUATE ENGINEERS

A large Copper Mining Company in Northern Rhodesia invites applications from Electrical and Mechanical Graduate Engineers. Basic starting salary will depend on qualifications and experience. There are also generous pension, bonus and cost-of-living benefits. Write, giving particulars of age, qualifications and experience, to R.34.—BOX No. E9721, "The Engineer." A

H. J. HEINZ CO., LTD., have a vacancy at their Harlesden Headquarters for a DRAUGHTSMAN, aged 25–40. Applicants should have some experience of plant layout, services, light machinery and vessel design. There is considerable variety in the work, and the conditions are excellent, the company's welfare services including a non-contributory pension scheme, free life insurance, and a flourishing sports and social club. Hours are 8.45 a.m.–5 p.m., 5-day week.—Please apply in writing, stating age, qualifications and experience, to Personnel Officer, at Harlesden, London, N.W.10. E9774 A

HARDINGE MACHINE TOOLS, LTD., require a highly qualified DESIGNER, particularly experienced in design development of light machine tools of at least Swiss precision. Applicants must be capable of ideas which will keep Hardinge machines in the forefront of their field. This is a senior appointment carrying high salary.—Apply, Managing Director, Hampton Road West, Hanworth, Middlesex. E1514 A

JIG AND TOOL DRAUGHTSMEN required by the Hoffmann Manufacturing Company, Limited, Ball and Roller Bearing Manufacturers. We have openings for men with particular experience of tooling Multi-Spindle Autos. Conditions of employment are good and posts are pensionable.—Please apply, giving full details of age, training and experience, to Personnel Manager, The Hoffmann Manufacturing Company, Limited, Chelmsford, Essex. E9808 A

JIG AND TOOL DRAUGHTSMEN required by the Hoffmann Manufacturing Company, Limited, Ball and Roller Bearing Manufacturers. We have openings for men with particular experience of Press Tool Work. Conditions of employment are good and posts are pensionable.—Please apply, giving full details of age, training and experience, to Personnel Manager, The Hoffmann Manufacturing Company, Limited, Chelmsford, Essex. E9809 A

JUNIOR DRAUGHTSMAN required. Experience in mechanical handling plant an advantage. Good prospects.—British Industrial Sand, Ltd., High Street, Godstone. E1497 A

JUNIOR INSTRUMENT DRAUGHTSMEN, having completed National Service, required for work on large chemical plant installations. A.E.S.D. minimum rates or above. Five-day week and superannuation scheme.—Apply by letter, giving details of technical education to the Chief Draughtsman, Laporte Chemicals Limited, Clifton House, Euston Road, London, N.W.1. E9355 A

KODAK, LTD.,
require
SHIFT PLANT ATTENDANT

for feed water system, including demineralisation plant in modern industrial power station. Previous experience desirable, but not essential.

Basic rate 228s. 6d., plus shift allowance and merit rating scheme in operation, together with free life insurance, sickness benefit and pension plans.

Please write or call, Men's Personnel Dept., Kodak, Ltd., Wealdstone, Harrow, Middlesex. E9787 A

MACHINE TOOL ENGINEER required for responsible post in connection with the manufacture and maintenance of machine tools within a large engineering organisation situated in the South East of England. The successful applicant, after an initial short period, will be appointed as Shop Manager. Applicants, preferably between the ages of 35/45, must have sound practical and technical knowledge of machine tools and must be capable and experienced in the planning and control of a Department employing upwards of 200 skilled men. The post is pensionable. Please apply for an application form and giving at the same time any supporting information.—BOX No. E1498, "The Engineer." A

MECHANICAL DRAUGHTSMAN. — Large commercial and industrial organisation has vacancy in London head office for a Senior Mechanical Draughtsman. Applicants must have had extensive experience in layout of machinery and boilers and possess a good all-round knowledge of general engineering. For the right man the prospects are excellent and there is a non-contributory pension scheme. Write, giving age and details of experience.—BOX No. E9750, "The Engineer." A

MECHANICAL ENGINEER.—Applications are invited from qualified Mechanical Engineers by the leading valve manufacturers in Australia, to join their Development Engineering Section. The successful applicant will be concerned with the design and development of new designs of valves for the steam, oil and chemical industries and for water reticulation. The company offering this position has a staff of over 600 personnel and manufactures the most comprehensive range of valves in the British Commonwealth. Assistance to travel to Australia will be provided. Salary will be in accordance with experience and qualifications.—Applications should be forwarded to Wm. Coward and Co., Limited, 3, St. James's Square, London, S.W.1. E1518 A

MECHANICAL ENGINEER

Davy and United Engineering Company Limited, have a vacancy for a qualified man with good practical experience of large and medium sized Machine Tools and other plant, including Overhead Cranes, Boilers and Compressors.

Mechanical Degree and/or Membership of the Institution of Mechanical Engineers preferred. A knowledge of Electrical Engineering would be an added advantage. Age range approximately 30/45 years.

The successful applicant will be required to supervise and control maintenance and overhaul programme under the general guidance of the Works Engineer. Attractive salary commensurate with experience and qualifications. Good conditions, dining facilities, contributory superannuation scheme.

Apply, quoting this newspaper, with full details, to: Personnel Officer, Davy and United Engineering Company Limited, Darnall Works Prince of Wales Road, Sheffield, 9. E9735 A

MEDIUM-SIZE FIRM of general mechanical engineers in London area require a qualified ENGINEER, capable of working with minimum of supervision, on design of special-purpose machinery, including contract progressing. Excellent prospects, leading to position of Chief Engineer. Age 30/40. Full details of training and experience, with salary required.—BOX No. E1486, "The Engineer." A

MECHANICAL ENGINEER

required for engineering developments in the manufacturing division of an internationally known firm producing heavy plant for the oil, chemical, iron and steel and atomic energy industries.

The work is of an unusually varied nature, ranging from the investigation and analysis of machine and fabricating shops operations to the development of new products.

The engineer appointed will be expected to work closely with works management, production engineering, design and shop management staff, whose ideas and requirements are guaranteed to provide many interesting and important projects. This is an excellent opportunity to obtain first-class experience of works operations in an organisation where ability is recognised and rewarded.

Applicants, of approximate age between 25 and 35 years, should have a Degree or similar qualification in Mechanical Engineering, and experience in design or production or operational research. The starting salary will depend upon qualifications and experience.

Please write, in confidence, giving details of age, qualifications and experience, to BOX No. E9790, "The Engineer." A

MONSANTO CHEMICALS LIMITED
require
YOUNG MEN WITH ENGINEERING INTERESTS AND EXPERIENCE

to take part in an expanded programme of use, development and technical service work relating to Polystyrene, Polyethylene and other thermoplastic materials.

Applicants should possess suitable technical qualifications with a bias towards engineering (at least H.N.C. with early prospects of qualifying Grad.I.Mech.E., B.Sc., or equivalent) and preferably have had some experience with plastics. The posts will entail co-operation with user industries and should appeal to young men with imagination, initiative, a capacity to co-operate and a real interest in the technology of plastics.

The post is permanent and a good salary will be paid commensurate with qualifications and/or experience. Five-day week, staff restaurant and non-contributory pension scheme are in operation.

Applications in writing, giving full details of age, training, qualifications and experience, should be sent to the Chief Personnel Officer, Monsanto Chemicals, Ltd., 10–18, Victoria Street, London, S.W.1. E9801 A

NATIONAL ESTABLISHED ENGINEERING CONSULTANTS require SENIOR DESIGNER DRAUGHTSMEN, qualified and experienced in Reinforced Concrete design. Permanent, pensionable posts in the East Midlands and London area. Salary and expenses £950–£1150, according to experience and qualifications. Reply with personal details.—BOX No. E9799, "The Engineer." A

NATIONAL ESTABLISHED ENGINEERING CONSULTANTS require REINFORCED CONCRETE DESIGNER DRAUGHTSMAN. Salary and expenses £850/£950 p.a. Senior, permanent, pensionable appointment in the London area. Must be H.N.C. standard and experienced. Full personal details.—BOX No. E9638, "The Engineer." A

NATIONAL ESTABLISHED ENGINEERING CONSULTANTS offer permanent, pensionable posts for SENIOR DESIGN AND LAYOUT DRAUGHTSMEN in the London area. Salary and expenses £900/£1050 p.a., commensurate with qualifications, which should be H.N.C. or a minimum of ten years' experience in one or more of the following: Light Mechanical Precision Engineering, Small Mechanisms, Electro-Mechanical, Electrical or Electronic work. Full details.—BOX No. E9637, "The Engineer." A

NATIONAL ESTABLISHED ENGINEERING CONSULTANTS offer permanent and pensionable posts for DRAUGHTSMEN and SENIOR DESIGN DRAUGHTSMEN in the London area. Appropriate technical qualifications and experience in one or more of the following: Chemical Plant, Piping Work, Pressure Vessels, Ventilating on general mechanical plant layout. Salary and expenses £950/£1050 p.a., according to experience and qualifications. Full personal details.—BOX No. E9636, "The Engineer." A

OVERSEAS TECHNICAL SALES REPRESENTATIVE

Armstrong Siddeley (Brockworth), Ltd., Diesel Engine Division, invite applications for the position of Overseas Technical Sales Representative. It is essential that the successful applicant has extensive experience of overseas markets, with particular emphasis on South East Asia. He must be prepared to travel as required in the course of his duties. He must also have a sound knowledge of all aspects of small diesel engines and their installation. Applications, stating age, qualifications, experience and salary required, will be treated in the strictest confidence and should be addressed to the Personnel Manager, Armstrong Siddley (Brockworth), Ltd., Diesel Engine Division, Hucclecote, Glos. E9723 A

PLANT DEPOT MANAGER required by C.E. Contractor with depot S.W. London. Applicants must be fully experienced in the maintenance and repair of all contractors' plant and equipment, have proven administrative ability, and knowledge of overseas operating conditions. Attractive salary and house available.—Write, BOX E 606, L.P.E., Romano House, 399/401, Strand, London, W.C.2. E9713 A

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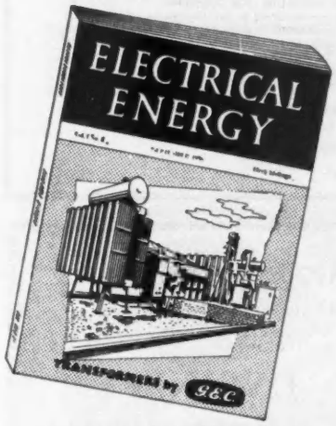

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SITUATIONS VACANT

PRODUCTION ENGINEER

required to manage a rapidly developing Engineering Works near London. Applicants must submit evidence of wide experience in making mechanical handling equipment and in controlling labour. This unique opportunity has excellent prospects for further advancement and calls for a man of dynamic personality. A generous salary is envisaged. Applications, furnishing full personal details, including educational and engineering background.—BOX No. E9770, "The Engineer." A

PROJECT MANAGER

An important company engaged in the Design, Procurement and Construction of major Chemical and Oil Refinery Plants, require a Senior man to take control of large projects.

Applicants should already hold a similar position and be suitably qualified. Salary open to discussion but in the region of £3000 p.a. Normal benefits of a well-established and stable company.

All enquiries will be treated confidentially. Our staff have been informed of this vacancy. Write full particulars.—BOX No. E9797, "The Engineer." A

RICHARDSONS, WESTGARTH (HARTLEPOOL), LTD.,

have a vacancy at Hartlepool for :—

COMMISSIONING ENGINEER

for large size

GAS TURBINE POWER GENERATING PLANT

The post is permanent and will carry a good salary commensurate with the qualifications and experience of the successful applicant.

There are pension and life assurance schemes in operation.

Applications, which will be treated in strict confidence, should be addressed to the Group Personnel Officer, Richardsons, Westgarth and Co., Ltd., P.O. Box 2, Wallsend, Northumberland. E1480 A

RICHARDSONS WESTGARTH (HARTLEPOOL), LIMITED,

have a vacancy for an

ELECTRICAL ENGINEER

This is a first-class opportunity for a Graduate who has had experience in turbo-alternator design and commisaioning.

There are pension and life assurance schemes in operation.

Applications will be treated in strict confidence and should be addressed to the Group Personnel Officer, Richardsons Westgarth and Co., Ltd., Northumberland Engine Works, Wallsend. E9785 A

ROAD CONSTRUCTION MACHINERY DESIGNER REQUIRED. Experience in design of Motor Road Rollers an advantage. Good salary, pension and life insurance scheme. Apply, giving full particulars of experience and salary expected.—BOX No. E9633, "The Engineer." A

ROLLER BEARING MANUFACTURERS require SENIOR SALES ENGINEER (REPRESENTATIVE) for the South of England, preferably already residing south of the Thames. Necessary qualifications and sound engineering training and previous sales experience. Attractive salary and prospects.—Write for local interview to the Sales Manager, Cooper Roller Bearings Co., Ltd., King's Lynn, Norfolk. E9742 A

SENIOR DEVELOPMENT ENGINEER

An exceptional opportunity for a Mechanical Engineer, in the 30–40 age group, wishing to broaden his responsibilities, occurs in our organisation. The successful candidate would, after experience of our products, take charge of our Design Office and Development Department, comprising a staff of about 45 in all.

An Honours Degree in Mechanical Engineering, followed by responsible development or design experience in light to medium engineering are the minimum technical qualifications. Experience of research, especially in machine dynamics, strength of materials or elasticity, would be considered valuable.

Staff conditions, salary, pension scheme, &c., are up to the standard expected by those genuinely qualified for this post.

Candidates should write initially to the Secretary, The British Northrop Loom Company, Ltd., Blackburn, Lancashire. E1517 A

SENIOR DRAUGHTSMAN in charge of small Drawing Office with progressive Fabrication Engineers. Must have experience of design and estimating of industrial structures and platework, coupled with administrative ability. Accustomed to dealing direct with clients. This is a position where future promotion is envisaged for the right man. Minimum age 28. Salary commensurate with experience and qualifications. Superannuation scheme, 5-day week.—T. Darnell and Sons, Ltd., Colwick Estate, Colwick, Nottingham. E1508 A

SENIOR MECHANICAL DRAUGHTSMAN required by London brewery, conversant with plant layout and machine design, able to develop and detail from rough sketches and ideas.—BOX No. E1484, "The Engineer." A

SITUATIONS VACANT

SENIOR ELECTRICAL AND SENIOR MECHANICAL ENGINEERS required by consulting engineers for work in London on industrial projects. Applicants should be qualified and have had considerable experience of comprehensive contracts. Knowledge of contract procedure and specifications essential, and experience as a project engineer would be an advantage.—Full particulars to BOX No. E9779, "The Engineer." A

SENIOR REINFORCED CONCRETE DESIGNERS AND DESIGNER DRAUGHTSMEN required for permanent positions on long-term development programme in East Midlands. Qualifications, H.N.C. or Graduate of Institution. Salary and expenses according to experience and qualifications. Applicants please state full personal details.—BOX No. E9639, "The Engineer." A

SERVICE ENGINEER.—A company specialising in land and marine steam boiler auxiliary equipment has a vacancy for a Service Engineer operating from London. Write, giving full details of age, experience and salary required, to BOX No. E1489, "The Engineer." A

SETTER MECHANIC, experienced packaging machinery, required for North London factory. Excellent conditions, non-contributory pension scheme.—Apply, Personnel Officer, International Chemical Co., Ltd., Braydon Road, N.16. E9806 A

SHEEPBRIDGE ALLOY CASTINGS, LTD., Hamilton Road, Sutton-in-Ashfield, Notts, have a VACANCY on their OUTSIDE SALES STAFF. Permanent, progressive position with superannuation scheme in operation. A good engineering background is essential and a knowledge of the stainless steel industry would be an advantage.—Write, giving details of previous experience, positions held and salary required, to Personnel Officer." E9795 A

SOLARTRON MECHANICAL ENGINEER

Solartron Industrial Controls, Ltd., is seeking a Junior Mechanical Engineer to work on the development and design of hydraulically actuated handling mechanisms. Applicants should have H.N.C. or equivalent, and should have completed an apprenticeship in medium or light engineering, followed by development experience on light mechanisms, preferably involving small hydraulic systems.

Solartron is a young and vigorous organisation with a programme of rapid expansion ahead, and offers excellent career opportunities.

Although based initially at our Dorking, Surrey, Research Laboratories, it will be necessary to move in about seven months' time to a new factory now being built at Farnborough, Hants. Please apply to:

The Group Personnel Officer,
SOLARTRON ELECTRONIC GROUP, LTD.,
Queens Road,
Thames Ditton,
Surrey. E9786 A

SOUTH AFRICA.—Leading mining company requires a qualified DESIGNER/DRAUGHTSMAN for work in Kimberley, experienced in layout, design and estimating of metalliferous mining or materials handling plant, both structural and mechanical. Ability to carry out initial design and organise subsequent stages in Design office. Company housing provided for married man. Passages paid. Benefit Society and pension fund. Starting salary £1200–£1450, according to qualifications and experience, plus cost-of-living allowance.—BOX No. E9743 "The Engineer." A

SOUTH AMERICA DESIGNER-DRAUGHTSMAN

required by large mining company with extensive open-cast mines, refining plants, railroad and shipping facilities, situated in the North of Chile, at present modernising and expanding facilities.

Applicants should be experienced in general and structural engineering and thoroughly acquainted with general engineering office procedures. The work involves chemical plant design and layout and supervision of draughtsmen.

Applicants should have proved design ability and be prepared to accept responsibility. Qualifications: Age 28 to 35, A.M.I.Mech.E. or H.N.C.

Contract for 3 years with local yearly vacation and 3 months' vacation on full salary if contract renewed. Outward and return passages provided for applicant and family. Attractive salary in U.S. Dollars based on qualifications and experience.

Write.—BOX Z572, c/o Streets, 110, Old Broad Street, E.C.2. E9800 A

SUPERINTENDENT.—A sound, practical Engineer required to Manage the Mechanical Stoker and Furnace Department of an old-established company in Yorkshire, West Riding. Additional products—Elevators, Conveyors, &c. Must be capable of carrying out boiler tests and advising on fuel efficiency generally. Salary up to £850, plus production bonus (at present 25 per cent.). Contributory pension scheme and free life assurance. Write in confidence for attention of General Manager, marking envelope "Private and Confidential."—BOX No. E1502, "The Engineer." A

TECHNICAL AUTHOR required, not over age 45, to assume responsibility for the compilation of operating and maintenance instruction manuals dealing with the company's machinery. This interesting and progressive pensionable staff position would appeal to a suitably qualified Mechanical Engineer (H.N.C.), with a bias towards technical writing.—Applications should be addressed to the Personnel Manager, Mollins Machine Co., Ltd., Evelyn Street, London, S.E.8. E9791 A

Classified Advts. continued on page 114

SITUATIONS VACANT

TECHNICAL SALES REPRESENTATIVE

Armstrong Siddeley (Brockworth), Ltd., Diesel Engine Division, require a Technical Sales Representative in the North of England and Scotland.

Applicants must have a sound knowledge of diesel engines and their applications. The present Armstrong Siddeley range of diesel engines is from 6 h.p. to 33 h.p., single, twin and three cylinder models. Applications should give full details of age, qualifications, experience and salary required.—They will be treated in the strictest confidence and should be addressed to the Personnel Manager, Armstrong Siddeley (Brockworth), Ltd., Diesel Engine Division, Hucclecote, Glos. E9724 A

THE NESTLE COMPANY LIMITED, HAYES, MIDDLESEX, require young GRADUATES between the ages of 23–28 years, with 2nd or 3rd Class Honour or Pass Degrees in Engineering or Chemistry. Successful applicants would be given either a specific project to study under supervision, or general training on the manufacturing side, which includes milk, cocoa and coffee products and chocolate and sugar confectionery, &c. As there is a possibility that visits abroad, during training, may be necessary, a knowledge of French and/or German would be most useful but is not essential. Future Managers and Executives will be selected from the successful candidates and they must, therefore, be able to work with and direct others. Pension scheme, sports and social club, &c. Salary will be commensurate with age, qualifications and experience.—Application, with full details, should be addressed to the Personnel Officer. E1470 A

WANTED, COMPETENT ENGINEER, 30 to 40 years of age, to operate from the London office of an Engineering concern situated in the West Riding of Yorkshire, whose products are iron and steel works equipment, chemical and gas works plant. Must be capable of obtaining and negotiating complete contracts, including erection work. Must have suitable technical and designing qualifications and not afraid of responsibility. Car available. Superannuation scheme in operation. State age and fullest particulars.—BOX No. E9776, "The Engineer." A

WANTED,—SENIOR JIG AND TOOL DRAUGHTSMEN required by company situated near Bournemouth, manufacturing specialised components for the motor industry. Experience of machine tool design and knowledge of hydraulics an advantage. Write, stating age, details of experience, technical training and salary required.—BOX No. E9640, "The Engineer." A

WITH THE CONSIDERABLE DEVELOPMENT OF WALLS FOOD FACTORIES in the West London area, vacancies have arisen for a DESIGNER and a GENERAL DRAUGHTSMAN. Ordinary National Certificate in Mechanical Engineering is essential and it would be preferred if the successful candidates were proceeding with studies towards A.M.I.Mech.E. The work will involve design and layout of food process production equipment and will prove a most satisfactory sphere for a man who is interested in bold, original schemes. It is preferred that candidates are under 40 years of age. Starting salary will not be less than £900 per annum, plus comprehensive superannuation and sickness benefit schemes.—Applications should be addressed to Company Personnel Manager (quoting ref. No. 120), T. Wall and Sons (Meat Products), Ltd., Atlas Road, Willesden, London, N.W.10. E9745 A

WORKS SUPERINTENDENT REQUIRED

immediately by expanding firm of precision engineers in the West Midlands area, employing over 3000 people.

An experienced practical engineer of first-class standing is required, and applicants must be conversant with modern production methods and must be able to handle labour and be a good disciplinarian.

The situation offers excellent prospects for the right type of man, it is permanent and progressive and a good superannuation scheme is available.

Write, giving full details of past experience, positions held, salary, &c., in chronological order, to BOX No. E9784, "The Engineer." A

WELLINGTON TUBE WORKS, LIMITED

GREAT BRIDGE, TIPTON

Applications are invited for the following vacancies in their Tube Fabrication Department :—

STRUCTURAL DESIGNER. Minimum qualification H.N.C. Experienced in the design of buildings, gantries, towers, &c. Structural Design Office experience essential, but need not necessarily be in tube.

DRAUGHTSMAN. Minimum qualification of O.N.C. or equivalent experience required for detailing tubular fabrications.

ESTIMATOR, for compiling estimates from drawings of tubular structures. Practical shop floor experience, including machining and welding advantageous.

The structural use of tubes is increasing rapidly and these positions offer considerable scope for advancement in an expanding department.

Applications, stating age, qualifications, experience and salary required, should be addressed to :—

THE SECRETARY. E9728 A

SITUATIONS VACANT

STRUCTURAL ENGINEER

The Tube Fabrication Department of Wellington Tube Works, Limited, requires a highly qualified Engineer. The duties include development through design, technical discussion with users of the Company's products, and the conclusion of contract award.

Applicants should be between 30 and 40 years of age and must have a University Degree, A.M.I.Struct.E. or equivalent. Industrial experience is essential, but not necessarily in tubular construction, as the successful applicant will have a period of training within the Company's organisation.

Applications, giving full particulars of age, qualifications, and experience, which will be treated in confidence, should be addressed to THE SECRETARY, WELLINGTON TUBE WORKS, LIMITED, GREAT BRIDGE, TIPTON, STAFFS. E9729 A

PRODUCTION PLANNING ENGINEER

required by

DAVID ROWAN & COMPANY LIMITED

Marine Engineers and Boilermakers

231 ELLIOT STREET GLASGOW, C3

to plan production in their Heavy, Medium and Light Machine Shops. Applicant should have had experience in planning technique and practical knowledge of Machine Shop production methods in the Heavy Engineering Industry.

Please state experience and salary required. E9671 A

MSL

have been retained to advise on the appointment of a

WORKS MANAGER

for a company in the London Area employing approximately 400 in the packaging industry. The company is one of a large group with progressive ideas and has recently embarked on a re-organisation to meet changing conditions.

The Works Manager will be responsible to the General Manager for the efficient operating of the factory, covering planning, manufacture, maintenance, service and transport facilities, and will be expected to assist in the introduction of improved methods.

Candidates should have professional qualifications in engineering preferably A.M.I. Mech.E., and have attained a position of responsibility as works manager or production manager in the light engineering, packaging, or paper industries. It is essential they have had experience of modern budgetary control, method study, material handling and production planning methods.

Preferred age 35–40. Salary £2,500–£3,000, and an attractive pension scheme.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details, in confidence, quoting reference G.682 to M. B. Berks.

MANAGEMENT SELECTION LIMITED, 17, Stratton Street, London, W.1

E9734 A

SITUATIONS VACANT

METROPOLITAN-VICKERS ELECTRICAL CO. LTD.

TRANSFORMER AND RECTIFIER DESIGN, DEVELOPMENT AND APPLICATION ENGINEERS

There are vacancies at the Company's new Factory at Wythenshawe for Senior and Junior Design, Development and Application Engineers in the fields of :

LARGE POWER TRANSFORMERS
INSTRUMENT TRANSFORMERS
MERCURY ARC AND GERMANIUM RECTIFIERS

Minimum qualification required is the Higher National Certificate. Candidates who have little or no transformer experience are invited to apply, as training will be given, where necessary, to successful applicants. Commencing salary will be according to age and qualifications.

There are good transport facilities to this new factory, where working conditions are ideal.

Applicants are requested to write, quoting reference J.10, to :

Personnel Manager,
Metropolitan-Vickers Electrical Co., Ltd.
Trafford Park,
Manchester, 17. E9773 A

THE ENGLISH ELECTRIC COMPANY LTD., WHETSTONE, Nr. LEICESTER,

require an

INSTRUMENT ENGINEER

to develop and design instrumentation systems for a variety of mechanical and electrical experiments. The applications include research and development work associated with

NUCLEAR REACTORS STEAM, GAS AND WATER TURBINES

Applicants must have considerable instrument experience and be capable of devising mechanical, electrical and electronic systems. Preference will be given to applicants who have a Degree or H.N.C. in Engineering.

Please write, giving full details of qualifications and experience, to Dept. C.P.S., 336/7, Strand, W.C.2., quoting ref. E 1812A. E9762 A

a vacancy exists for a

QUALIFIED ENGINEER

in a senior position

in the

ENGINEERING HEADQUARTERS

(located in the South Midlands)

of a

large company with wide interests and many production units.

Applicants should be between 30 and 40 years of age and possess a degree or equivalent qualification. It is desirable that they should have had experience in the basic aspects of efficient generation, utilization and process integration of factory services and also be used to preparing specifications, plant selection and general contract engineering.

Salary commensurate with ability and experience.

enquiries to Box No. E100, "The Engineer"

A

SITUATIONS VACANT

MECHANICAL ENGINEER FOR AUTOMATION

A group of companies with substantial interests in the manufacture of machine tools wish to apply modern methods of automatic control and electronic computing to the industry.

The proposed programme of work involves the complete reassessment of machine tools within the context of modern control engineering techniques and a limited number of vacancies exist within the group for GRADUATE MECHANICAL ENGINEERS holding a First or Second Class Honours Degree.

Applicants should preferably have had practical experience in mechanical engineering design and/or research experience in one of the following subjects :—

(a) Mechanical vibrations.
(b) Bearings, friction, lubrication.
(c) Machining and cutting processes.
(d) Hydraulics.

Application will be made for successful candidates to enter the Department of Engineering, Cambridge University, as post-graduate students to receive a two-year course of research training in Machine Tool Dynamics.

This will give employees the opportunity to take a higher degree after which they will be expected to take a leading role within the research and development activities carried on in our organisation.

It is expected that men engaged on this basis will, if suitable, ultimately have opportunities of promotion to executive posts in the group.

Initial salaries will be within the range of £800–£1100 per annum, depending upon the suitability of the applicant.

Applications should be addressed to :

The Director of Research,
The Staveley Research Department,
Clapham,
BEDFORD. E9718 A

SITUATIONS VACANT

DESIGNER-DRAUGHTSMEN

PIPING
PIPE SUPPORT
INSTRUMENT
ELECTRICAL
PRESSURE VESSELS
& HEAT EXCHANGERS

Designer-Draughtsmen in these categories are cordially invited to contact KELLOGG INTERNATIONAL CORPORATION, leading Design and Construction Engineers of world-wide repute in the petroleum and chemical industries. We provide good working conditions and excellent personnel benefits with opportunities for advancement, and have immediate vacancies in our new additional premises. Please write to the Personnel Manager,

KELLOGG INTERNATIONAL CORPORATION
7-10 CHANDOS STREET, LONDON, W.1 *or telephone MUS 4010 quoting reference 120/G*

E9740 A

What on 'Earth's' happening?

With the introduction of those incredible satellites, ever-curious man takes yet another step forward, another step into realms unknown. Not content with the oceans' depths or the high reaches of our immediate heavens, man has now ventured into spheres beyond our earth's perimeter. Such is advancement; but there remains ample scope for research and development on terra firma; work on projects of immediate and vital importance. Such is the case with steel and such will be the job of the men who take this opportunity of joining the New Development Department of the Corby works of Stewarts and Lloyds—one of the largest integrated iron, steel and steel tube works in Europe. Five day week. Good welfare, canteen and recreational facilities. Superannuation and life assurance scheme. Staff hostel for single men. Favourable local housing conditions.
In addition to these vacancies, there are also openings in other drawing offices, both at Corby and elsewhere in the Company.

Applicants should possess Higher National Certificates but those with Ordinary National Certificates should apply if they have reasonable experience in design. All applications will be treated as confidential and should be made, giving details of age, qualifications, experience and salary required, to:—

MANAGER/PERSONNEL

S&L **STEWARTS AND LLOYDS LIMITED**

CORBY, NORTHANTS E99 A

THE GENERAL ELECTRIC COMPANY LIMITED

ATOMIC ENERGY DIVISION
CONTRACTS DEPARTMENT

Vacancies exist at the Company's Office at Erith, Kent, for

ENGINEERS

to handle mechanical and electrical aspect of contracts for complete

NUCLEAR POWER STATIONS

Preference will be given to men holding H.N.C. or equivalent qualification

Positions are also available in the Contracts Drawing-Office for

JUNIOR AND SENIOR DRAUGHTSMEN

for the following work on Nuclear Power Station contracts :—

(a) Development and detailing of mechanical and structural items.
(b) Preparing of electrical cabling and wiring layouts.
(c) Arrangement and layout work on steam, water, and gas pipework and on station auxiliaries.
(d) Detailing and checking work on pressure vessels manufactured to Class I standards.

Applications, giving full particulars of qualifications, experience and age, should be made to Personnel Manager (C.E. and D.), The General Electric Company, Limited, Erith, Kent.
E9720 A

RATEFIXER FOR TIME STUDY DEPARTMENT

Experienced in speed and effort rating, incentive schemes and negotiation procedure, to be engaged on machining and assembly work, principally for the Motor Industry.

The Company is an old-established one, with modern factory and offices. Canteen, sports club and pension scheme. Three weeks' annual holiday.

SUCCESSFUL APPLICANTS WILL BE SUBSEQUENTLY REHOUSED IN THE NEW TOWN AFTER A REASONABLE PERIOD.

Applications to :

Labour Manager,
Alford and Alder (Engineers), Limited,
Maylands Avenue,
Hemel Hempstead, HERTS. E9751 A

SITUATIONS WANTED

GENERAL MANAGER.—A.M.I.Mech.E., A.M.I.P.E. (40), experience production automobiles, aero engines and general engineering. Some iron foundry experience, also commercial. Excellent record labour relations. Present salary £3000, but change to where experience on precision work can be fully utilised more important.—BOX No. E1519, "The Engineer." B

YOUNG MECHANICAL ENGINEER (25 Grad.I.Mech.E., five-year studentship with large diesel manufacturers, sales and service experience, seeks position of some responsibility with a view to higher management in the future.—BOX No. E1500, "The Engineer." B

SUB-CONTRACTING

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone, Byron 1178). E575 MW

ACCURATE MACHINING
also on Models and Prototypes, &c.
MILLING TURNING
JIG BORING PLANING
PRESS TOOLS, JIGS AND FIXTURES
HORIZONTAL BORING
GIVE US YOUR DIFFICULT JOBS
LANDEN (ENGINEERS), LTD.
1A, AUBERT PARK, LONDON, N.5.
CANonbury 1075 E871 MW

ENGINEER/DESIGNER with sales experience SEEKS Medium/Light ENGINEERING FIRM to ASSIST HIM in the DEVELOPMENT and MANUFACTURE of his LATEST ARTICLES. Write.—BOX No. E9714, "The Engineer." MW

KELLERING and Profile Milling in all metals. Send us your die blocks to copy from wood or plaster masters. Up to 5ft. by 8ft. max. size. We are die copiers to the trade.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Tel.: Knottingley 2743/4). E948 MW

MIDLANDS DESIGN OFFICE, specialising in medium-size mobile hydraulic equipment, has Capacity for Design and Manufacture of Prototypes. Production Capacity also available.—BOX No. E1476, "The Engineer." MW

PRECISION ENGINEERS.—Personal service for prototypes, small quantity machined parts and equipments. Design and development undertaken. A.I.D. Approved.—Bowyer, Smyth and Partners, Ltd., Vineyard Walk, Clerkenwell, E.C.1 ('Phone, TERminus 5113/4). E650 MW

SUB-CONTRACTING

SHEET METAL WORK, NON-FERROUS CASTINGS AND BRASS FITTINGS. Capacity available for work of highest class.—BOX No. E1501, "The Engineer." MW

PRATCHITT BROTHERS, LTD., Denton Iron Works, Carlisle, having well-equipped engineering shops and ironfoundry, invite inquiries for general Engineering. Structural and Plate Work from firms wishing to have plant made to their own designs and specifications. E720 MW

BUSINESS OPPORTUNITIES

INVENTORS.—A well-equipped firm of Fabricating and General Engineers is prepared to examine any new Invention, particularly in the Mechanical or Agricultural field, with a view to producing on a Royalty basis. Write, giving brief details.—BOX No. E1334, "The Engineer." O

INVESTMENT IN PARTNERSHIP IN BRAZIL

Partnership available in existing industrial enterprise in Sao Paulo. Importers of engineering products and manufacturers of armatures. Selling agency of a German factory assured by long-term contract. Factory consists of approximately 10,000 sq. ft. in excellent condition and location, whole property 70,000 sq. ft. Existing production uses quarter only of available floor space, with room for expansion. Own electrical generating plant. Good market for present production of armatures.

Partner will be required to invest about £40,000 sterling. Instead of partnership the whole firm could be taken over. Good capital investment in Brazil. Also suitable for those who desire to expand capital already invested in that country. Reply, BOX No. E1483, "The Engineer." O

FOR HIRE

LATTICE STEEL Erection Masts (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1 ('Phone, SLOane 5259). E112 K

Classified Advts. continued on page 116

DRAWING & DESIGN SERVICE

A TEAM of fully experienced TRACERS will undertake to prepare Tracings of your Drawings on paper or linen. Ask us to quote.—BOX No. E1520, "The Engineer." 8

MACHINERY Etc. WANTED

WANTED, Machines of all Types.
CASH PAID.
Norman E. Potts (B'ham), Ltd., 130, Moseley Road, Birmingham, 12. VIC. 1278, 1279, 1270, 0856. E123 F

WANTED.—Extension Jibs for Rapier 8¼-ton Super Crane.—BOX No. E9624, "The Engineer." F

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FRED WATKINS (BOILERS), LTD.
RECONDITIONED MACHINERY FOR SALE

STEAM BOILERS.—Cochran Vertical (New), 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia.. 100/150 lb. w.p.; reconditioned 8ft. 6in. down to 3ft. dia.; Economic, 4ft. to 11ft. 6in. dia.; including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p.; 300 reconditioned Vertical Crosstube, all sizes.

AIR COMPRESSORS.—Broomwade 510 cu. ft.; Tilghman 365 cu. ft.; Broomwade 300, 200 and 130 cu. ft.; all motorised.

200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb pressure.

ELECTRIC MOTORS.—150 Totally Enclosed and Flameproof Motors up to 100 h.p.

CRANES.—Mobile 10-ton Lorain, lorry mounted, 30ft.–70ft. extendable jib; 8¼-ton Ransomes Diesel-Electric, 1948; 4-ton Coles Diesel-Electric; 3-ton Jones Super 40 (3); Neals 2-ton Diesel, 20ft. jibs (2); Derrick, 10-ton Henderson Steam; 5-ton Butters Electric travelling type, 90ft. jib; 5-ton Wilson Electric, 70ft. jib; 3-ton Rushworth Electric, 65ft. jib; Steam Loco. 18-ton Brownhoist, 50ft. jib; 10-ton Coles, 40ft. jib; 8-ton Wilson, 35ft. jib; 5-ton Smith, 50ft. jib; 5-ton Cowans Sheldon, 50ft. jib; 5-ton Grafton, 38ft. jib; E.O.T., 10-ton Vaughan, unused, 40–60ft. span; 5-ton Henderson, 24ft. 7½in. span, 1946; 5-ton King, 29ft 3in. span; 2-ton Morris, 18ft. span; 2-ton Smith, 34ft. span.

RAILWAY MATERIAL.—Ruston 80/88 h.p. Diesel Loco., electric start, flameproof; Peckett 14in. by 22in. and 7in. by 12in. Steam Locos.; 3 miles 20 lb. Track, 24in. gauge bogies, turnouts, locos., &c.

STEEL PIPING.—50,000ft., 2in. Galvanised new 60,000ft., black new; 5000ft., 8in. seamless; 1000ft., 12in. seamless; 500ft., 14in. seamless; 400ft., 18in. riveted; 280ft., 21in. o.d. welded flanged; 3800ft., 21in. seamless flanged; 500ft., 24in. riveted; 1450ft., 27in. o.d. welded flanged; 216ft., 48in. riveted; 216ft., 60in. riveted.

CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.

VALVES.—Exceptional Surplus Ministry Lot New Stainless Acid Cocks and Valves, over 5000, immediate delivery, below makers' prices. Large stock, all sizes, Parallel Slide Sluice, Gunmetal, Reducing and Check Valves. List on request.

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One Rapier 8¼-ton Super Diesel/Electric, fully slewing jibs to 50ft.
Two Rapier 8¼-ton Super Petrol/Electric, fully slewing.
Two Rapier 6-ton Standard Petrol/Electric, solid tyres, diesel conversion available.
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One 2-ton Hydracrane, petrol/hydraulic on 4 by 4 high speed chassis.

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Large stock of modern Presses up to 10,000 tons capacity, for Forging Forming, Extruding, Baling and other duties.
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Replant Works, Woolwich Industrial Estate,
London S.E.18.
Tel.: Woolwich 7611 (6 lines). E9711 G

NEW COLCHESTER "MASCOT" S.S. and S.C. Gap Bed LATHE. 8¼in. H.C. by 54in. B.C. Price £898. Delivery immediately ex our London stock.—Welling and Welling, Ltd., 4, Victoria Street, London, S.W.1 (Tel.: ABBey 2341). E988 G

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50 TONS NEW SLIGHTLY DEFECTIVE B.H. RAILS, 100 lb. yard, chiefly 60ft. lengths.
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ABOUT 80 COMPLETE TURNOUTS, 24in. gauge, made from 20 lb. F.B. Rails, mounted on steel sleepers, 15/16ft. overall.
20 TONS SECOND-HAND COACH SCREWS, 6¼in. by 1¼in., Standard Railway Pattern.
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NEW 20,000 c.f.m., 100 p.s.i.g., Electrically-driven TURBO-COMPRESSOR SET by DANIEL ADAMSON, driven through Davey Brown reduction gearbox by Met.-Vick. motor, 4145 b.h.p., 1500 r.p.m., 6600/6300/3/50, with control gear.
AVAILABLE AT REDUCED PRICE.

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PILKINGTON 2 cwt. size Pneumatic Power Hammer, Overhanging type, without slides, arranged motor drive for 400/3/50, self-contained pump, longest stroke approximately 17in., centre of ram to back 14½in., diameter of ram 9¼in., weight about 60 cwt., complete with separate anvil.
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Photographs of the above are available.
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FROST 8ft. by ¼in. CRAMP FOLDER. Power lift to beam, beam has swing end. M.D. 400/3/50.
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HEAVY DUTY

MILLING MACHINES
IN STOCK

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V3 MASERATI High Power Dial Type Vertical Miller with sliding and swivelling spindle head, rapid power feeds to all table movements by separate motor, working surface table 59in. by 13¾in., capacity 35¼in. by 11in. by 18¼in., 20 spindle speeds 18–1200 r.p.m., h.p. motor 10.
No. 3 CINCINNATI High Speed Dial Type, table size 58¾in. by 15in., capacity 34in. by 16in. by 16in.
No. 4 CINCINNATI High Speed Dial Type, table size 78¾in. by 16in., capacity 42in. by 16in. by 16in.
47V HERBERT Kneeless Type, multi-motor drive, table 72in. by 17in., capacity 48in. by 16in., maximum distance table top to spindle nose 23in., 16 spindle speeds from 21–750 r.p.m.
CVM25 KENDALL & GENT (Kneeless), circular table type, table diameter 30in., capacity 30in. by 26in. by 32in.
28/60 CINCINNATI Hydrotel, fixed height bed, single power control lever, stepless feed regulation, rapid power traverse, power down feed to spindle, multi-motor drive, table working surface 28in. by 83in., capacity 60in. by 30in. by 14in., vertical travel of spindle head gap 38in., 16 spindle speeds from 52–1300 r.p.m.

HORIZONTAL

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No. 4 CINCINNATI Medium Speed Dial Type, table working surface 74¼in. by 16in., capacity 42in. by 14in. by 20in.
S2 CRAVEN UNIVERSAL, table size 55in. by 13in., capacity 36in. by 10in. by 16in.

PRODUCTION

3/36 CINCINNATI Plain Hydromatic, table size 52¼in. by 15in., travel 36in.
4/48 CINCINNATI Plain Hydromatic, table size 77½in. by 16½in., travel 48in.

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E210 G

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6-ton Rapier Standard Pet./Elec. Mobile Crane on solid rubber tyres.
6-ton Rapier Super Pet./Elec. Mobile Crane, on solid rubber tyres.

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SHOTBLASTING PLANT FOR SALE, complete with compressor, inter-cooler, receiver, motor, starter, cabinet, piping, &c. Offers invited.—LINES BROS., Ltd., Morden Road, Merton, S.W.19. E1506 G

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2 cwt. MASSEY CLEAR SPACE TYPE, stroke 14in., 200 blows p.m., 12½ h.p. induction motor, 400/440/3/50 cycles, starter, &c.
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10in. between centres.
Sliding bed.
12 spindle speeds 2·7–330 r.p.m.
Pedestal type tool holder and compound slide rest on separate bed mounted in front of machine.
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Power feeds and rapids to all movements.
4 face plate chucks.
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1	14½×24	040 Hawthorn Leslie	—	160	22
2	14×22	040 Barclay	—	160	22
3	14×22	040 Barclay	—	160	22
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5	14×22	040 Barclay	—	160	22
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8	17×24	040 Bagnall	1940	160	36
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By Order of the Minister of Supply

GOVERNMENT SURPLUS STORES

AUCTION PROGRAMME

1958		*Main Location*	*Auctioneers*
January 13–15	Vehicles, motor cycles, and miscellaneous stores	Central Ordnance Depot, Bicester, Oxon	MIDLAND MARTS, LTD. (Dept. L), Market Square, Bicester, Oxon. (Tel.: 73.)
January 21–24	Vehicles, etc., including:—	M.O.S. Storage Depot, Ruddington, Notts.	WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 47271.)

Passenger and load-carrying vehicles of all types, earth moving and road construction plant, mobile lifting equipment, fitted mobile workshops, pneumatic tools, motor cycles, scrap lead/acid batteries, used vehicles tyres, etc.

January 21–22	Miscellaneous stores, including:—	Central Ordnance Depot, Didcot, Berks	SIMMONS & SONS (Dept. L), 12, Station Road, Reading, Berks. (Tel.: 54025.)

Large quantity of chemicals, engineers' and carpenters' tools, tentage, webbing equipment, cable, rope, hoisting tackle, blankets, textiles, laboratory equipment, rivets, nails, bolts, polishes and waxes, paint, matchets and sheaths, miscellaneous furniture, kitchen equipment, etc.

January 28–29	Machine tools, clothing and miscellaneous stores	M.O.S. Sub Depot, Lily Lane, Byley, Middlewich, Cheshire. (Sale at New Islington Public Halls, Ancoats, Manchester.)	J. H. NORRIS & SON (Dept. L), 9, Albert Square, Manchester, 2. (Tel.: Blackfriars 8373.)
January 31	Miscellaneous stores	Returned Stores Depot, British Railway Sidings, Colley Lane, Bridgwater, Somerset. (Sale at Royal Clarence Hotel.)	J. H. PALMER & SONS (Dept. L), Bank Chambers, Burnham on Sea, Somerset. (Tel.: 2326.)

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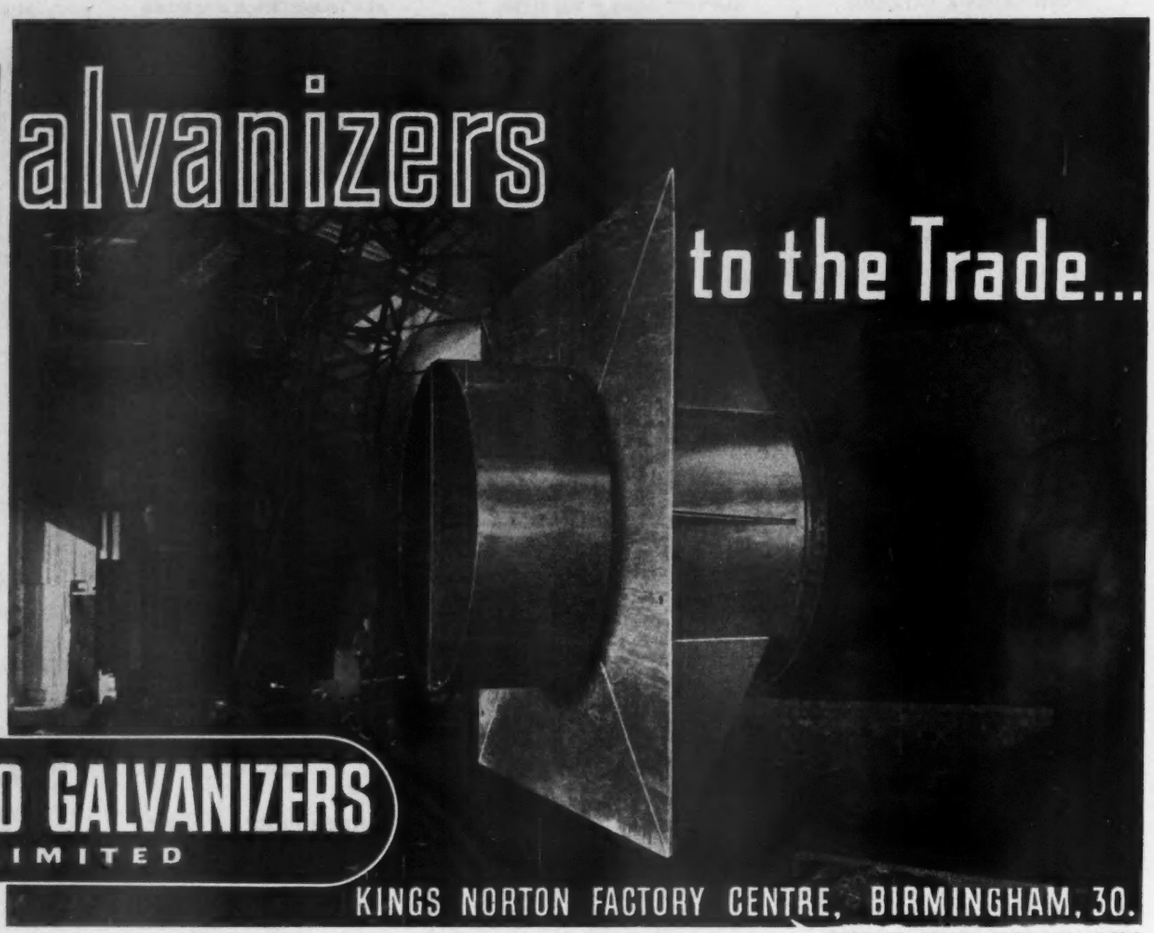

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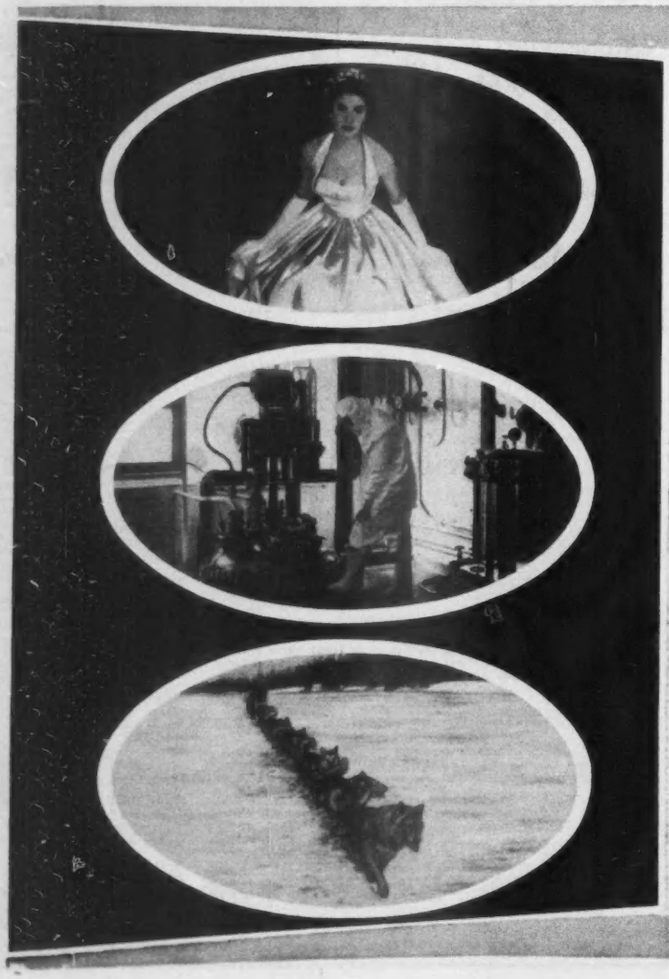

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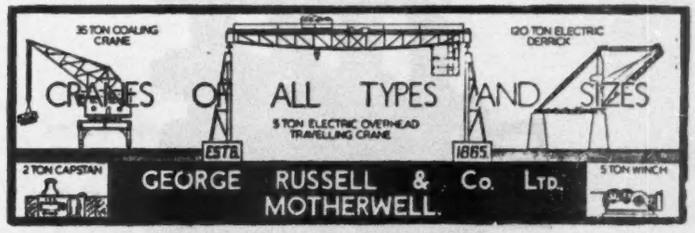

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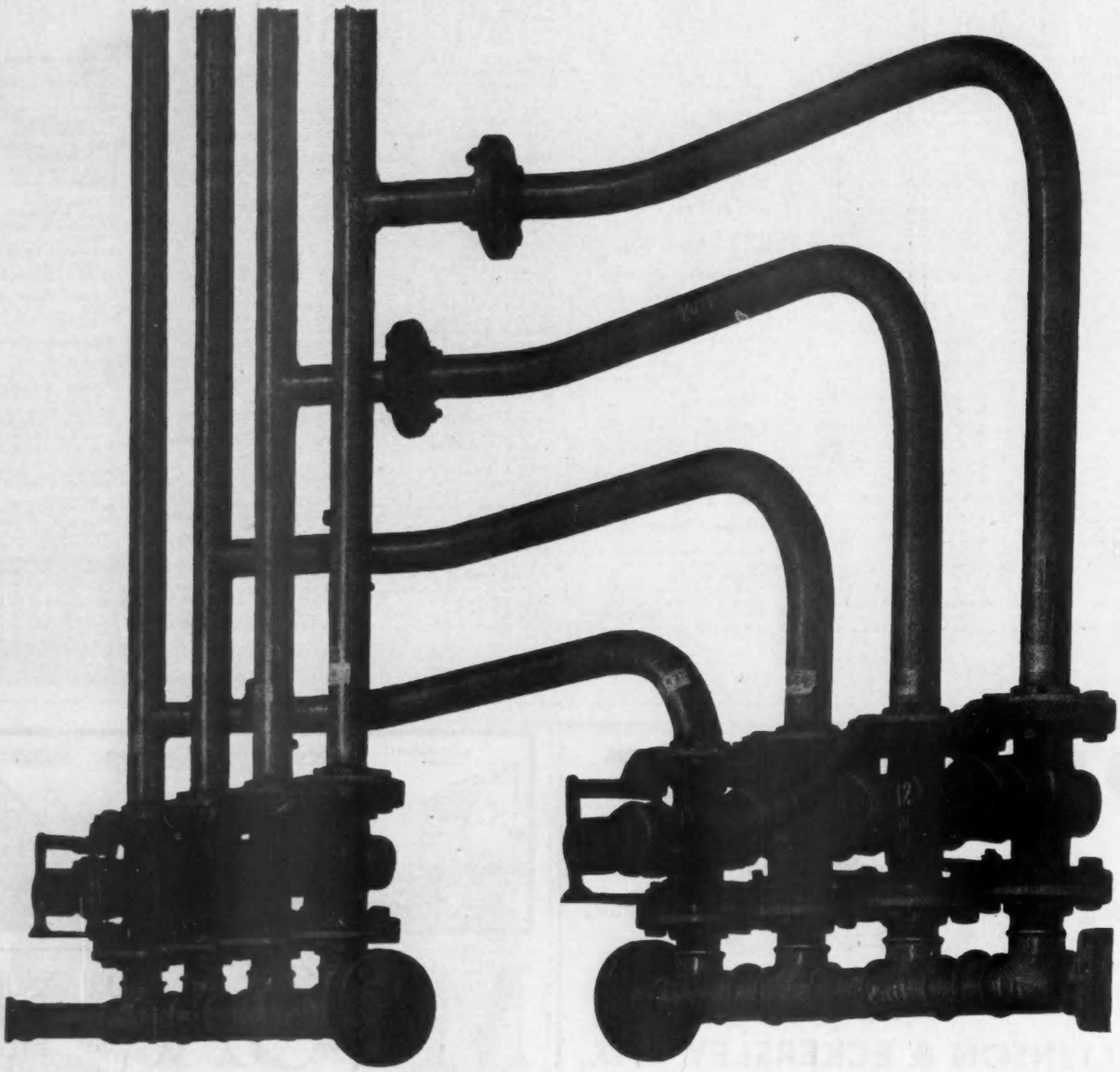

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